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JANUARY/FEBRUARY 2008

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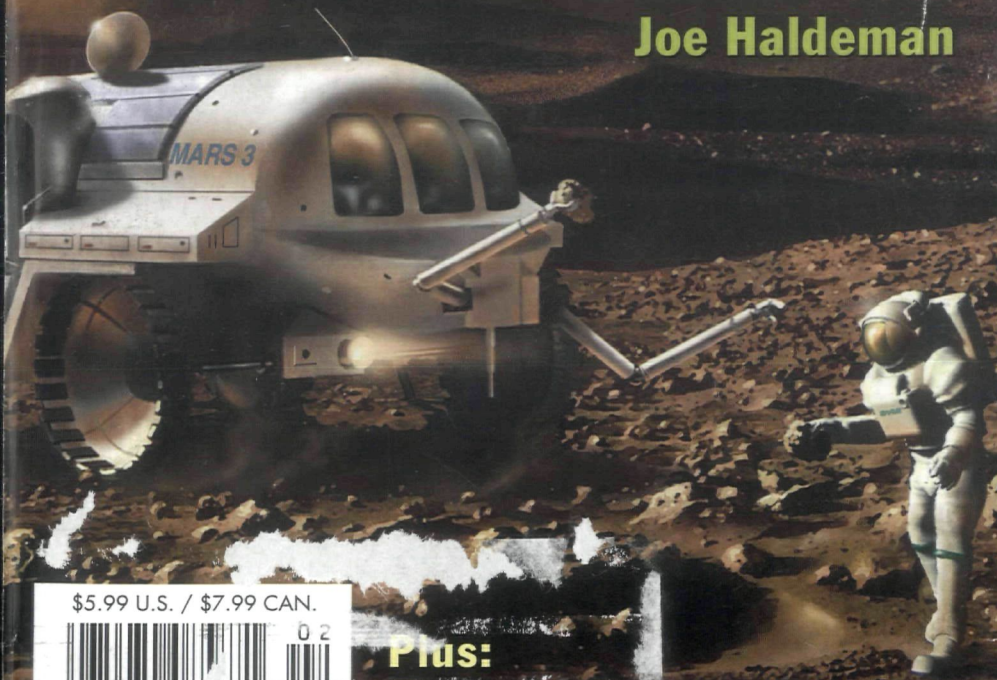
Joe Haldeman



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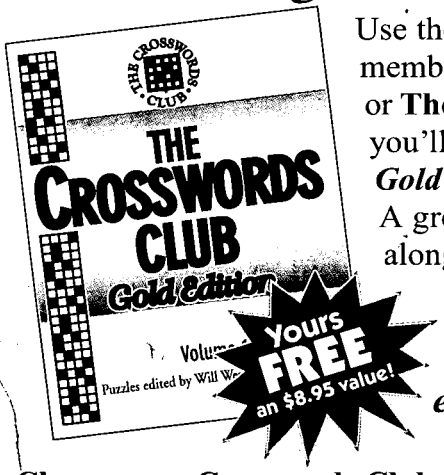

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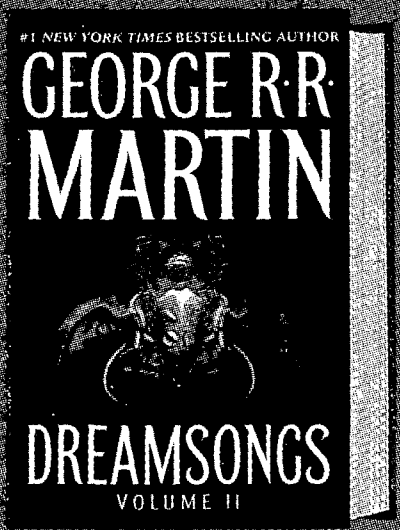

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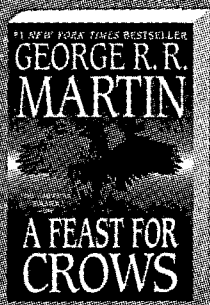

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Vol. CXXVIII No. 1 & 2
January/February 2008

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ATTENTION

If you've been reading *Analog* more than a little while, you know we sometimes publish serials. A novel won't fit in one issue, but some of the meatiest stories are that long and tell stories that many of our readers like, so when we get one of those we divide it into two, three, or four installments of 20,000 or so words each and run them in consecutive issues, each but the last ending with "TO BE CONTINUED" or "TO BE CONCLUDED." Some readers like to collect all the parts and then read the whole thing straight through, but some read each part as it comes. For them, a month or so elapses between sections, so as a memory refresher we precede each part except the first with a brief synopsis of what has happened so far.

I realize that not everyone likes serials (or anything else), but I think most of us can agree that, given that enough readers like them to warrant publishing them, it makes sense to end a part with a notice that there's more to come, and/or open with a brief recap of the story to that point. But you'd probably think it was pretty silly if we did the same thing for a short story or novelette that almost everybody will read in one sitting.

Imagine, for example, reading the first two-and-a-half pages of Isaac Asimov's classic novelette "Nightfall," and then being subjected to an italicized paragraph that insults your intelligence by asking you,

Will Theremon persuade Aton to give him what he wants in the brief time he's been allotted to make his case? What does *he want? Read on, and find out!*

And then, after the line space Asimov included to show a dramatic break, another such paragraph:

Director Aton of Saro University believes the world is doomed: civilization will end in four hours. Newsman Theremon doesn't think so, and wants Aton's permission to cover the story live in the university's observatory. He has five minutes to make his case. . . .

Now imagine going through that every couple of pages, every time the author left a break. The first time might amuse, the second would surely annoy, and I don't think it would take many before you were ready to throw the book across the room. You might never pick it back up, and never get near the story's unforgettable ending.

Sounds pretty ridiculous, doesn't it? Yet recently I've been seeing essentially the same thing being done routinely on television. I don't even watch much television, yet I've seen it over and over, in documentaries and even movies: each of the frequent commercial breaks is introduced by a preview of what the next segment will hold; and when the new segment finally begins, it starts not by taking up where the show left off, but with a summary of what the whole show is about and where things stood at the end of the last segment.

Now I realize commercial breaks are often much longer than most viewers would prefer, but they're not *that* long—not so long that many viewers of even minimal intelligence are likely to forget the little they've seen so far, or

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where the action or narration paused. So why are so many stations doing this, wasting time that could be used to continue telling the story or expounding on the topic to which they're supposedly devoting a half hour or hour? After all, not only are commercial breaks long, but the actual show segments between them are short—so those unnecessary teasers and recaps take significant bites out of what's supposed to be show time. During one recent documentary on an otherwise generally respectable channel, I timed a few of each kind of time: commercials, teasers, recaps, and (last and dangerously close to least) actual new show content. I didn't do it rigorously enough to give you exact figures, and it may vary from show to show; but my ballpark estimate was that commercials consumed at least a fifth of the nominal time allotted for the show, and teasers and recaps took at least a fifth of what was left over.

Which means the viewers were getting a lot less actual show than they were being led to believe.

When I first noticed this phenomenon I thought it was just another of those goofy gimmicks that people often feel obliged to try out, even if they ought to know better. It soon became apparent that it was an actual trend, or fad, and it has now been going on quite a while. When it had been around long enough for me to start looking for a reason, my first thought was that it was just laziness and/or cheapness, two of the most popular motivations in the world. It was as simple as my previous paragraph: if you pad your show with a lot of repetition that looks like content but isn't, maybe you can fool enough of the people to get away with producing less material, and that will save you time and money. After all, it's cheaper and easier to produce a minimal amount of show and then recycle pieces of it as padding than to actually spend each segment saying and showing something new.

But it kept happening, so I kept thinking. Pretty soon it occurred to me that it might actually reflect a much bigger and more pervasive cultural problem in at least two ways: an epidemic of short attention span, real and/or perceived.

First, the practice may reflect stations' and/or sponsors' belief that most viewers can't sustain a thought or follow its development for an hour, or even a significant fraction of one. That belief may or may not be true, but there's plenty of evidence that it's widely held. Even New York City's one surviving classical music radio station has apparently been convinced of it, though not quite so severely, and I'm pretty sure it isn't true of much of their audience. I can easily believe it's true of some other audience segments; but regardless of how true it is, if stations and/or sponsors believe it, they'll act accordingly. So a major reason for the effect I'm describing may be that the people producing a show don't be-

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lieve their viewers can remember what it's about through four or five minutes of commercials.

Second, the prevalence of channel surfing suggests that at least a sizable part of the audience really does have a short attention span and little patience, but they have something else that sponsors want: money. So the heavy infestation of teasers and recaps may be at least partly a ploy to hook and hold surfers who chance upon a show in midstream, by offering frequent reminders of what it's about and enticements to stay tuned for more.

Either way, it seems to reflect a cultural tendency (which I am by no means the only person to notice) toward short attention spans. And that can have consequences on several levels.

The first, and perhaps least important, is that it further dilutes the content of television shows—which, with relatively few exceptions, have never been noted for either depth or breadth. Any show that spends sizable chunks of its time repeating and anticipating itself will necessarily be more superficial than one that tries to cover as much new and solid ground as possible in each segment.

Second, and perhaps a bit more important, is that widespread catering to short attention spans encourages them, likely making them even more prevalent (which in turn makes them a bigger market segment and therefore even more influential on future content). That, of course, is more important if and only if you believe that matters for some reason beyond itself.

Which leads us to the third consequence, which is the biggie: If more and more people become unable or unwilling to stay with a show or a train of thought for more than a few minutes, that means they will be unable or unwilling to think meaningfully about most of the important issues we will all have to deal with in the real world. Sound bites may be catchy, but actually making sensible decisions about things like global warming, privacy versus security, and population growth (to name just a few) will require paying close attention and actually following arguments that may be lengthy, complicated, and even multibranched.

I wouldn't count on a population of people who expect everything delivered in sound bites, or five-minute chunks with reminders every few minutes of what was said in the last few minutes, to be able to do much of that.

But they will be able to vote.

Think about that. ■

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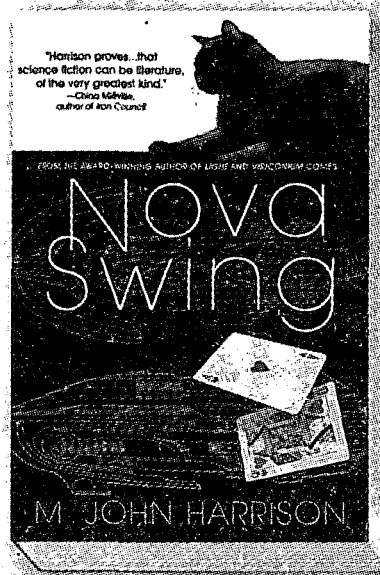
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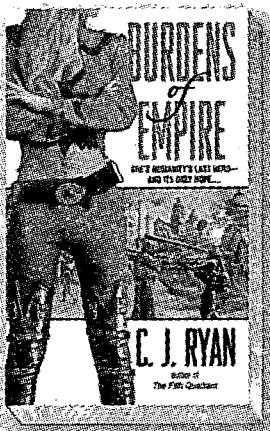

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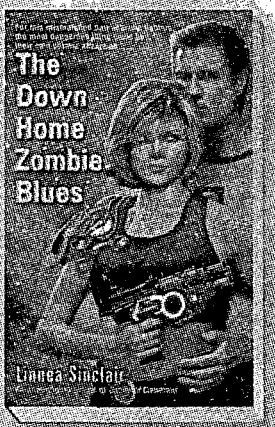

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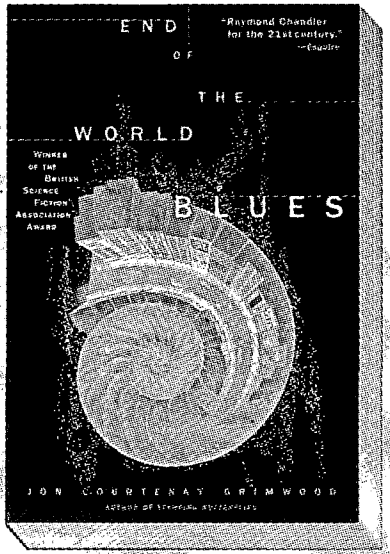

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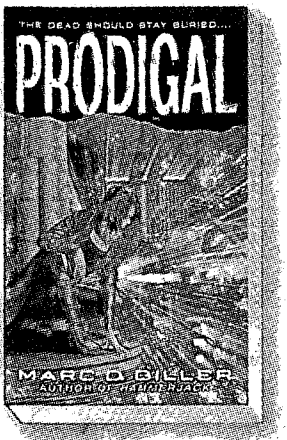

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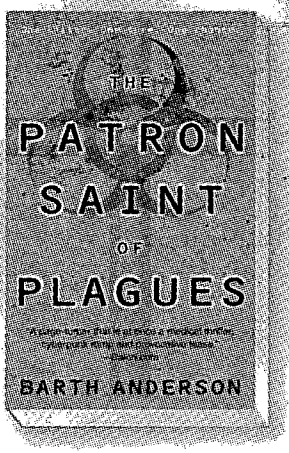

Your Journey Awaits.

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Marsbound

part I of III

Joe Haldeman

Humans have been moving into new frontiers as long as they've been human. Some things they take with them; others they discover accidentally. . . .

"The butterfly counts not years but moments, and has time enough."
—*Rabindranath Tagore*

1. The Undead

It wasn't a lot of luggage for five years; for the longest journey anyone has ever taken. We each had an overnight bag and a small titanium suitcase.

We stepped out into the warm Florida night and carried our bags to the curb. I looked back at the house and didn't feel much. We'd only lived there two years and wouldn't be coming back. I'd be twenty-four then, and getting my own place anyhow.

Dad pointed out Jupiter and Mars, both near the horizon.

The cab hummed around the corner and stopped in front of us. "Are you the Dula party?" it said.

"No, we're just out for a walk," Dad said. Mother gave him a look. "Of course we are. It's three in the goddamned morning."

"Your voice does not match the caller," the cab said. "After midnight I need positive identification."

"I called," my mother said. "Do you recognize this voice?"

"Please show me a debit card." A tray slid out and Dad flipped a card onto it. "Voice *and* card."

The doors opened silently. "Do you require help with your luggage?"

"Stay put," Dad said, instead of no. He's always testing them.

"No," Mother said. The luggage handler stayed where it was and we put our small bags in the back, next to where it crouched. Its eyes followed us.

We got in, Mother and me facing Dad and Card, who was barely awake. "Verify destination," it said. "Where

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are you going, please?"

"Mars," Dad said.

"I don't understand that."

Mother sighed. "The airport. Terminal B."

"The undead," Card said in his zombie voice.

"What are you mumbling about?"

"This thing you humans call a cab." His eyes were closed and his lips barely moved. "It does not live, but it is not dead. It speaks."

"Go back to sleep, Card. I'll wake you up when we get to Mars."

2. Good-bye, Cool World

It's the only elevator in the world with barf bags. My brother pointed that out. He notices things like that; I noticed the bathroom. One bathroom, for twenty people. Locked in an elevator for two weeks. It's not as big as it looks in the advertisements.

You don't call it "the elevator" once you're in it; the thing you ride in is just the climber. The Space Elevator, always capitalized, is two of these climbers plus 50,000 miles of cable that rises straight up into space. At the other end is the spaceship that will take my family to Mars. That one will have *two* bathrooms (for thirty people) but no barf bags, presumably. If you're not used to zero-gee by then, maybe they'll leave you behind.

This whole thing started two years ago, when I was young and stupid, or at least sixteen and naive. My mother wanted to get into the lottery for the Mars Project, and Dad was okay with the idea. My brother Card thought it was wonderful, and I'll admit I thought it was spec, too, at the time. So Card and I got to spend a year of Saturday mornings training to take the test—just us; there was no test for parents. Adults make it or they don't, depending on education and social adaptability. Our parents have enough education for any four people but otherwise are crushingly normal.

These tests were basically to make *us,* Card and me, seem normal, or at least normal enough not to go detroit locked up in a sardine can with twenty-nine other people for six months.

So here's the billion-dollar question: Did any of the kids aboard pass the tests just because they actually were normal? Or did all of them also give up a year of Saturdays so they could learn how to hide their homicidal tendencies from the testers? "Remember, we don't say anything about having sex with little Fido."

We flew into Puerto Villamil, a little town on a little island in the Galapagos chain, off the coast of South America. They picked it because it's on the equator and doesn't get a lot of lightning, which could give you pause if you were sitting at the bottom of a lightning rod long enough to go around the Earth twice.

The town is kind of a tourist trap for the Space Elevator and the Galapagos in general. People take a ferry out to watch it take off and return, and then go to other islands for skindiving or to gawk at exotic animals. The islands have lots of bizarre birds and lizards. Dad said we could spend a week or two exploring when we came back.

If we came back, he didn't say. It's not like we were just moving across town.

Mother and Dad both speak Spanish, so they chatted with the taxi driver who took us from the airport to the hotel where we would get a night's rest before ferrying out to the elevator platform. The taxi was different, an electric jeep long enough to seat a dozen people, with no windshield and a canvas sun canopy rather than a roof. I asked what happens if it rains, and the driver summoned up enough English to say, "Get wet."

Card and I had a separate room, so Mom and Dad could have one last night of privacy. I hoped they were

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taking precautions. Six months of zero-gravity morning sickness? I wondered what they would name the baby who caused that. "Clean up your room, Barf." "No, you can't have the car, Spew."

(After all, they named Card Card and me Carmen, after an opera that I can't stand. "Tor-e-ador, don't spit on the floor. Use the cuspidor; that's what it is for.")

We dumped our bags and went for a walk, Card one way and me the other. He went into town, so I headed for the beach. (The *parentiosas* might have assumed we were going to stay together, but they didn't give us any specific orders except to be back at the hotel by seven for dinner.)

My last day on Earth. I should do something special.

3. Captain, my captain

The beach was less sand than rock, a jagged kind of black lava. The water swirled and splashed among the rocks and didn't look too great for wading, so I sat on a more or less smooth rock and enjoyed the sun and salt air. Real Earth air, breathe it while you can.

There was a big, gray iguana on a rock, maybe ten yards away, who ignored me. He didn't look real.

With the noise of the surf on the rocks I didn't hear the man come up behind me. "Carmen Dula?"

I jerked around, startled. He was a strange-looking older guy, maybe thirty, his skin white as chalk. With a closer look I saw it wasn't his skin; it really was something chalky, some kind of absolute sunblock. He was dressed in white, too, long pants and long sleeves and a broad-brimmed hat. Kind of good-looking aside from the clothes.

"Didn't mean to startle you." He offered his hand, dry and strong under the chalk. "I'm Paul Collins, your pilot. Recognized you from the passenger roster."

"The climber has a pilot?"

"No, just an attendant. What's to pilot?" He smiled, metal teeth. "I'm the pilot of the *John Carter of Mars*, this time out."

"Wow. You've done it before?"

He nodded. "Twice as pilot, once as copilot, there and back." He looked out over the ocean. "This'll be the last one. I'm staying on Mars."

"The whole five years?"

He shook his head. "Staying."

"For . . . forever?"

"If I live forever." He squatted down and picked up a flat stone and spun it out over the water. It skipped once. The iguana blinked at it. "I have to stay on either Earth or Mars. I'm sort of maxed out on radiation."

"God, I'd stay on Earth." Was he crazy? "I mean, if I was worried about radiation."

"It's not so bad on Mars, underground," he said, and tried another stone. It just sank. "Go up to the surface once a week. And those limits are for people who want to have children. I don't."

"Me neither," I said, and he was tactful enough not to press for details. "That's why you're so protected? I mean the white stuff?"

"No, more thinking about sunburn than hard radiation." He took off his hat and ran his fingers through his hair, what there was of it. It had obviously just been mowed, down to about a quarter inch except for a trim mohawk. "I haven't had a tan since I was . . . just a little older than you?"

"Nineteen," I said, adding six weeks.

"Yeah, twenty-one. That's when I joined the Space Force. They don't encourage tans."

That was interesting. "I didn't know the military was in on the Mars project." Officially, anyhow.

"They aren't." He eased himself

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down, stiffly, to sit on the rocks. "I quit after five years. It was all air flying. One suborbital, big deal. My tour was up, and this sounded more interesting."

"But you only get to do it three or four times?"

"There's that," he admitted, and threw a pebble at the iguana, missing by a mile. "They're way too conservative. I'm trying to change their minds."

"You couldn't do that better here on Earth?" I sat down next to him.

"Well, yes and no. Right now, if I stay there I'll be the only pilot *on* Mars, in case something goes wrong and they need one." He threw another pebble at the lizard and missed by even more. "Can't throw worth a shit since I went to space."

I took aim and missed the creature only by inches. It glared at me for a long second and slid into the water.

"Not bad for a girl."

I decided he was joking, but you couldn't tell from his expression. "I've heard that spaceflight can be hard on the muscles."

"It is. Even though you exercise every day, you get weaker. I'm weak as a kitten in all this gravity."

Inanely, I said, "I left my cat behind. In Florida."

"How old was it? Is it."

"Nine." Half my age; I hadn't thought of that.

He nodded. "Not too old."

"Yeah, but she won't be my cat when we get back."

"Might be. They're funny creatures." He rubbed his fingers as if they hurt. "So you're out of school?"

I shook my head no. "Going to start university by correspondence in September. Meryland."

"That'll be interesting. Odd." He laughed. "I partied through my first year; almost flunked out. Guess you won't have to worry about that."

"There aren't any parties on Mars? I'm disappointed."

"Oh, you have people, you have parties. Not too wild. You can't exactly send out for pizza and tap a keg of beer."

I had a sudden empty feeling, not hunger for pizza. I tried to push it away. "What *do* you do for fun? Go out exploring?"

"Yeah, I do that, go up and collect rocks. I'm a geologist by training, before I became a flyboy. Areologist now."

I knew about that; Ares is Greek for Mars. "Ever discover anything new?"

"Sure, almost every time. But it's like being a kid in a candy store, or it would be if you could find a store where they kept bringing in new candy. It's not hard to find stuff that's never been classified. You into geology?"

"No, more like English and history. I had to take Earth and Planet Science, but it wasn't my . . . favorite." My only C besides calculus, actually.

"You might learn to like it, once you have a new planet to explore." He wiggled a pebble out of the sand and looked at it, purple. Scratched it with his thumbnail. "Funny color for lava." He tossed it away. "I could show you around if you like. Mars."

Good grief, I thought, is the pilot hitting on me? Over thirty? "I don't want to be a bother. Just go out by myself and wander around."

"Nobody goes out alone," he said, suddenly serious. "Something goes wrong, you could be dead in a minute." He shrugged. "No 'could' about it, really. Mars is more dangerous than space, outer space. The air's so thin it might as well be a vacuum, for breathing."

"Yeah." It's not like I'd never seen a movie. "And then the sandstorms?"

"Well, they don't exactly sneak up on you. The main danger is getting careless. You've got ground and sky and gravity. It feels safer than space.

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But it's not." He looked at his watch and got up slowly. "Better get on with my exercise. See you tomorrow." He plodded off, obviously feeling the gravity.

I didn't ask whether he wanted company. Interesting guy, but we were going to be stuck in a room together for six months, and would see plenty of each other.

I didn't really feel like company at all. Maybe I could put up with the iguana. I picked my way out to the farthest place I could stand without getting my feet too wet, and watched the swirling, crashing water.

4. Last meal

On the way back to the hotel, I ran into Paul again. He was sitting alone in the shade of a thatched-roof patio outside a shabby bar called the Yacht Club, drinking a draft beer that looked good. I sat down with him but asked for a Coke, out of a vague concern that Dad might come by. Drinking with a man, oh my. I didn't know the legal age, either; if I was carded he'd find out I wasn't really quite nineteen.

It was a short date, anyhow. We'd just exchanged "where you from?" formalities when his cell pinged and he had to go off to the Elevator office. I did learn that he was from New Jersey but didn't have time to ask about Mafia connections or how to breathe carbon monoxide.

It was not a pleasant place to sit alone and wonder what the hell I was doing. My friends back home were about evenly divided between being jealous and wondering whether I'd lost my mind, and I was leaning toward the latter group. The Coke tasted weird, too. Maybe it was drugged, and when I slumped unconscious they would drag me into the hold of a yacht and smuggle me off to Singapore for a rewarding career in white slavery. Or maybe it was made with sugar instead of corn syrup. I left it, just to be on the safe side, and went on to the hotel.

Speaking of Coke, that's what we weren't having for dinner, no matter how much Card and I might have liked it. Or a pizza or hamburger or even a cold can of beans. Of course it was going to be fancy, the last real family meal for five years.

"Fancy" in the Galapagos was not exactly Park Avenue fancy. They don't serve up the iguanas, fortunately, but there wasn't much you'd find on a normal menu.

The hotel restaurant, La Casa Dolores, served mostly Ecuadorian food, which was not a surprise. I had *picadillo,* a Cuban dish that sounded like hamburger over rice, and pretty much was, although it tasted strange, like Mexican but with a lot of lemon juice and a touch of soap. Mother said that taste came from a parsley-like herb, cilantro. I trust they won't be growing it on Mars. Or maybe it's their only green vegetable.

Dad, being Dad, ordered the most outrageous thing on the menu: *tronquito,* bull penis soup, along with goat stew. I refused to look at any of it, and propped a menu up between us so I wouldn't be able to see his plate. Mother got *ceviche,* raw fish, which came with popcorn. It actually looked pretty good (I like sushi all right) but, excuse me for being practical, I had visions of thirty-three people waiting in line for that one bathroom. I didn't want too much adventure on the first day.

(Card ordered a sausage with beans, but only ate the beans. Maybe the sausage looked too much like Dad's soup. I didn't want to know.)

Mother asked what we'd done all afternoon. Card had a detailed analysis of the island's game rooms. Why go to Mars when you can virtual yourself all over the universe, killing aliens and rescuing big-breasted

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babes? If we run into aliens on Mars we probably won't have a single ray gun.

I told them I'd met the pilot. "You think he's only thirty?" Mother asked.

"Well, I haven't done the math," I said. "He was in the Space Force for five years? So he was at least twenty-three when he got out. He's been to Mars three times after that and probably spent some time on Earth in between. Got a geology degree somewhere."

"Maybe in space," Dad said. "Passing the time. He looked thirtyish, though?"

He was still eating, so I didn't look at him. "He looked zombie-ish, actually. I guess he could have been older than thirty."

I explained about the sunblock, but didn't mention his offer to take me rock hunting. Dad was being a little too protective of me, where males were concerned, and thirty-some probably didn't sound old to him.

"It's pretty impressive," Mother said evenly, "that he recognized you and remembered your name. I wonder if he knows all thirty-three of the passengers' faces. Or just the pretty girls."

"Please." I hate it when she makes me blush.

"Ooh, my pretty," Card said in his moron voice, and I kicked him under the table. He flinched but smiled.

"None of us are going to look all that great with no make-up," I said. Not allowed because of the air recycling. I wanted to get a lipstick tattoo when I heard about that, but neither parent would sign the under-eighteen permission form. It's not fair—Mother had a cheek tattoo done when she was not much older than me. It's way out of style now and she hates it, but that doesn't have anything to do with me. If you get tired of a lipstick tattoo, you can cover it with lipstick, brain.

"Levels the playing field," Dad said. "You'll be at an advantage with your beautiful skin."

"Daddy, don't." Mention the word "skin" and all of the acne molecules in my bloodstream get excited and rush to the surface. "I won't exactly be husband-hunting. Not with only five or six guys to choose from."

"It won't be quite that bad," Mother said.

"No, *worse!* Because most of them plan to stay on Mars, and I'm already looking forward to coming back!" I stood up and laid my napkin down and walked out of the restaurant as fast as dignity would allow. Mother said "Say *excuse me*," and I sort of did.

I managed not to start crying until I was up in the room. I was angry at myself as much as anything. If I didn't want to do this, why did I let myself be talked into it?

Part of it might have been the lack of boys where we were headed, but we'd talked that over. We'd also talked over the physical danger and the slight inconvenience of going to college a couple of hundred million miles off campus.

I stepped out onto the balcony to get some non-air-conditioned air and was startled to see the Space Elevator, a ruler-straight line of red light that dwindled away to be swallowed by the darkness. Maybe the first two miles of fifty thousand. I hadn't seen it in the daylight.

The stars and the Milky Way were brighter than we ever saw them at home. I could see two planets, but neither of them was Mars, which I knew didn't rise until morning. Dad had pointed it out to me on the way to the airport, which seemed like a long time ago. Mars was a lot dimmer than these two, and more yellow-orange than red. I guess "the Yellow Planet" didn't sound as dramatic as the red one.

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I went back down to the restaurant in time to get some ice cream along with a sticky sponge cake full of nuts and fruit. Nobody said anything about my absence. Card had probably been threatened.

Dad treated me in his delicate girl-in-her-period way, which I definitely was not. I'd gotten a prescription for Delaze and wouldn't ovulate until after we got to Mars. The download for the Space Elevator had described the use of recyclable tampons in way too much detail. With luck, I'd never have to use them in zero-gee, on the *John Carter.* Vacuum sterilizes everything, I suppose, so it was silly to be squeamish about it. But you're allowed to be a little irrational about things that personal. I managed to push it out of my mind for long enough to finish dessert.

Card and I tried TV after dinner, but everything was in Spanish except for CNN and an Australian all-news program. There was a Japanese Game Boy module, but he couldn't make it work, which didn't bother me and my book at all.

The room had a little fridge with an interesting design. Every bottle and box was stuck in place with something like a magnet. If you plucked out a Coke or something, the price flashed in the upper right-hand corner of the TV screen, and a note said it had been added to your room bill.

The fridge knew we were underage, and wouldn't let go of the liquor bottles. But we were evidently old enough for beer—a sign said the age was eighteen, but the fridge wasn't smart enough to tell whether it was serving me or my brother. So I had two beers, which helped me get to sleep, but Card stayed awake long enough to build a pyramid of six cans. I guess I could have been a responsible older sister and cut him off, but there wasn't going to be a lot of beer out on the Martian desert.

5. Pizza hunt

Our parents didn't say anything about the $52 added to our room bill for beer, but I suppose they took one look at Card and decided he had suffered enough. He'd told me he'd had beer "plenty of times" with his sag pals at school. Maybe it was the non-alcoholic variety. This was strong Dutch beer in big cans, and six had left a lasting effect. He was pale and quiet when we left the hotel and seemed to turn slightly green when we got aboard the boat, rocking in the choppy waves.

They didn't put the Earth end of the Space Elevator on dry land, because it had to be moveable in any direction. Typhoons come through once or twice a century, and they need to get out of the way. The platform it sits on can move more than two hundred miles in twenty-four hours, far enough to dodge the worst part of a storm. Or so they say; it's never been put to the test.

The ribbon cable that the carrier rides also has to move around in order to avoid trouble at the other end—dodging human-made space debris and the larger meteors, the ones big enough to track. (Small meteor holes are patched automatically by a little robot climber.)

The platform was about forty miles offshore, and the long, thin ribbon the elevator rides wasn't usually visible except for the bright strobe lights that warned fliers away. At just the right angle, the sun's reflection could blaze like a razor line drawn in fire; I saw that twice in the hour and a half it took us to cover the distance.

Paul Collins, the pilot, looked more handsome without the white war paint. He introduced himself to Card and my parents, proving that he could recognize passengers who weren't girls.

Before we got to the Space Elevator

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platform itself, we skirted around a much larger thing, the "light farm," a huge raft of solar power cells. They didn't get power directly from the Sun, but rather from an orbiting power station that turned sunlight into microwaves and beamed them down. Then it gets beamed right back up, in a way. The carrier's electric motors are powered by a big laser sitting on the platform; the laser's powered by the light farm. There's another light farm in the Ecuadorian mountains that beams power at the carrier when it's higher up.

The platform's like an old-fashioned floating oil rig, the size of an office building. The fragile-looking ribbon that the carrier rides spears straight up from the middle of it. The laser and the carrier take up most of the space, with a few huts and storage buildings here and there. It looked bigger from down on the water than the aerial pictures we'd seen.

We took an elevator to the Elevator. There was a floating dock moored to the platform. It was all very nautical feeling, ropes creaking as it moved with the waves, seagulls squawking, salt tang in the air.

Our boat rose and fell with the dock, but of course the open-air elevator didn't. It was a big metal cage that seemed to move up and down and sideways in a sort of menacing way as we bobbed with the waves. If you were sure-footed, you could time it right and just step from the dock onto the elevator. Like most people, I played it safe and jumped aboard as the floor fell away.

We all had identical little suitcases made of light titanium, with our ten kilograms of personal items. Twenty-two pounds didn't sound like very much, but we didn't have any of the stuff that you would normally pack for a trip, since we couldn't bring clothes or cosmetics. Three people had musical instruments too big to fit in the metal box.

The elevator clanked and growled all the way up. We clattered to a stop and got out onto a metal floor that felt like sandpaper, I guess some stuff to keep you from slipping. There was a guardrail, but I had a stomach flip-flop at the thought of falling back down the way we'd come. A hundred feet? Hitting the water would knock you out, at the very least.

Like we didn't have enough to worry about; let's worry about drowning.

To the salt air add a smell of oily grease and ozone tang, like a garage where they work on electric cars—and pizza? I'd have to check that out.

A guy in powder-blue coveralls, the uniform of the Space Elevator corporation, checked to make sure we were all there and there weren't any stowaways. We each picked up a fluffy towel and a folded stack of clothes. There was a sign reminding us that the clothes we were wearing would be donated to a local charity. Local? The Society for Naked Fish, I supposed.

I'd just had a shower at the hotel, but no such thing as too clean if you're going without for a couple of weeks. Or five years, if you mean a *real* shower.

The women's shower room only took six at a time, and I didn't particularly want to shower with Mom, so I left my stuff stacked by the wall and went off to explore, along with Card, who was looking a little more human.

The climber wasn't open yet, which was okay; we'd be spending plenty of time in it. It was a big white cylinder, about twenty feet in diameter and twenty feet tall, rounded on the top. Not a vast amount of room for forty people. Above it was a robot tug, all ugly machine. It would pull us up a few hundred feet, before the laser took over. It also served as a repair robot, if there was something wrong with the ribbon we were rid-

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ing on.

"Big foogly laser," Card marveled, and I suppose it was the biggest I'd ever seen, though truthfully I expected something more impressive, more futuristic. The beam it shot out was more than twenty feet in diameter, I knew, and of course it carried enough power to lift the heavy carrier up out of the Earth's gravity well. But it was only the size of a big army tank, and in fact it looked sort of military and menacing. I was more impressed by the big shimmering mirror that would bounce the laser beam up to us, to the photocells on the base of the carrier. Very foogly big mirror.

Three other young people joined us, Davina and Elspeth Feldman, sisters from Tel Aviv, and Barry Westling from Orlando, just south of us. Elspeth looked a little older than me; the others were between me and Card, I figured. Barry was a head taller than him, but a real string bean.

Elspeth was kind of large—not fat, but "large boned," whatever that really means. You couldn't help but note that most of us future Martians were on the small side, for obvious reasons. Someone has to pay for every pound that goes to Mars. Mother spelled out the inescapable math—every day, you need twelve calories per pound to stay the same weight: someone who weighs fifty pounds more than you has to pig down everything you eat plus one Big Mac every day. Over the six-month flight, that's eighty-five extra pounds of food, on top of the extra fifty pounds of person. So small people have a better chance in the lottery.

(They call it a "lottery" to sound democratic, as if every family had an equal chance. If that were true, I wouldn't have lost a year of Saturdays to the cause.)

Thinking of food made me ask whether anyone had found out where the pizza smell was coming from. No one had, so we embarked on a quest.

The search led, unsurprisingly, to a shed with a machine that dispensed drinks and food, alongside a microwave in which someone had recently burned a slice of pizza. Elspeth produced a credit card and everyone but my brother tried a slice. He didn't miss much, but we were more after the *idea* of pizza than the actuality. We didn't know for sure that there wouldn't be any pizza on Mars, but it seemed likely.

Barry and Card went off to play catch with a Frisbee while the rest of us sat in the shade. Neither Elspeth nor Davina was born in Israel; their family moved there after the war. Like ours, their parents are both scientists, their father a biologist and mother in nanotech, both of them involved in detoxifying the battlefield after Gehenna. Davina started to cry, describing what they'd had to do, had to see, and Elspeth and I held her until it passed.

Maybe there wouldn't be pizza on Mars, but there wouldn't be that, either. What hate can do.

6. Fears

There was no privacy in the shower, and not much water—I mean, all you could see in any direction was water, but I guess the salt would froog up the plumbing. So you had to push a button for thirty seconds of lukewarm unsalted water, and then soap up, push the button again, and try to get the soap off in another thirty seconds. Then do it again for your hair, without conditioner. I was glad mine was short. Elspeth was going to have the frizzies for a long time.

She has quite a dramatic figure, narrow waist and big in the hips and breasts. Mother describes me as "boyish," which I think is motherspeak for "titless wonder." Women built like Elspeth are always complaining about their boobs bumping into things.

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Things like boys, I suppose.

I liked her, though. It could be a little awkward, the first thing you do when you meet somebody is cry together and then strip naked and jump in the shower, but Elspeth was funny and natural about the latter. In the desert *kibbutz* where she spent summers growing up, they didn't have individual showers, and the water was rationed almost as severely as here.

Light blue used to be one of my favorite colors, but it does lose some of its charm when everybody in sight is wearing it. We left our "civilian" clothes in the donation box and put on Space Elevator coveralls and slippers. Then we went to the media center for lunch and orientation.

Lunch was a white cardboard box containing a damp sandwich, a weird cookie, and an apple. A bottle of lukewarm water, or you could splurge a couple of bucks on a Coke or a beer out of the machine. I got a beer just to see Card's reaction. He pantomimed sticking a finger down his throat.

The media center was one room with a shallow cube screen taking up one end of it. There were about fifty folding chairs, most of them occupied by powder-blue people. With everyone in uniform, it took me a minute to sort out Mother and Dad. Card and I joined them near the front.

The lights dimmed and we saw a mercifully short history of space flight, with an unsurprising emphasis on how big and dangerous those early rockets had been. Lots of explosions, including the three space shuttle disasters that all but shut down the American space program.

Then some diagrams showing how the Space Elevator works, pretty much a repeat of what we saw at the lottery-winner orientation in Denver a few months ago. Even without that, I wonder if anybody actually ever got this far without knowing that the Space Elevator was—surprise!—an elevator that goes into space.

It was interesting enough, especially the stuff about how they put it up. They worked from the middle out both ways, or up and down, depending on your point of view: Starting at GEO, the spot that orbits the Earth in exactly one day, and so stays overhead in the same spot, they dropped stuff down to Earth and raised other stuff up into a higher orbit at the same time. That way the whole thing stayed in balance, like a seesaw stretching out both ways at the same time.

We were headed for that other end, where the *John Carter* and the other Mars ship had been built and would launch from.

They spent a little time talking about the dangers. Sort of like a regular elevator in that if the cable snaps, you lose. You just fall a lot farther before you go splat. (Well, it's not that simple—Earth elevators have failsafes, for one thing, and the space elevator wouldn't actually go splat unless we fell from a really low altitude. We'd burn up in the atmosphere if we started falling at less than 23,000 kilometers; above that, we'd go into orbit and could theoretically, eventually, be rescued. But if the cable snapped that high, on our way to where the *John Carter* is parked, we'd go flinging off into space. Then that theoretical rescue would really be just a theory. There aren't any spaceships yet that could take off and catch up with us in time.)

There's a lot of dangerous radiation in space, but the carrier has a force field, an electromagnetic shield, for most of that. There are huge solar flares that would get past the shielding, but they're rare and give a ninety-one-hour warning. That's long enough to get back to Earth or GEO. The Mars ships and GEO have hidey-

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holes where everybody can crowd in to wait out the storm.

I'd read about those dangers before we left home, as well as one they didn't mention: mechanical failure. If an elevator on Earth develops a problem, someone will come fix it. It's not likely to explode or fry you or expose you to vacuum. I guess they figured there was no reason to go over that at this late date.

When we left home, a lot of my friends asked me if I was scared, and to most of them I said no, not really. They have most of the bugs worked out. It's carried hundreds of passengers to the Hilton space station, and dozens up to the far end, for Mars launch.

But to my best friend, Carol, I admitted what I haven't said even to my family: I wake up terrified in the middle of the night. Every night.

This feels like jumping off a cliff and hoping you'll learn how to fly.

7. Canned meat

We walked up a ramp, took a long last look at sea and sky and friendly Sun—it would not be our friend in space—and went inside.

The carrier had a "new car" smell, which you can buy in an aerosol can. In case you're trying to sell a used car or a slightly used Space Elevator.

There were two levels. The first level had twenty couches that were like old-fashioned La-Z-Boy chairs, plush black, with feet pointing out and heads toward the center. Each couch had a "window," a high-def shallow cube, all of which were tuned to look like actual windows for the time being. So there was still sun and sea and sky if you were willing to be fooled.

There was a little storage bin on the side of each couch, with a notebook and a couple of paper magazines. And that stack of barf bags.

Three exercise machines, for rowing, stair stepping, and biking, were grouped together where the ladder led up to the second level.

The woman who was our attendant, Dr. Porter, stood on the second rung of the ladder and talked into a lapel mic. "We have about sixty minutes till lift-off. Please find your area and be seated by then, strapped in, by one o'clock. That's 1300, for you scientists.

"I'll be upstairs if anyone has questions." She scampered lightly up the ladder.

I have a question, I didn't say. Could I just jump off and swim for it?

My information packet said I was 21A. I found the seat and sat down, half reclining. Card was next to me in 20A; Mother and Dad were upstairs in the B section.

Card took a vial out of his packet and looked at the five pills in it. "You nervous?" he said.

"Yeah. Thought I'd save the pills for later, though." They were doses of a sedative. The orientation show admitted that some people have trouble falling asleep at first. Can you imagine?

"Prob'ly smart." He looked pretty much like I felt.

The control console for the window came up out of the armrest and clicked into place over your lap. On one side it had a keyboard and various command buttons, but you could rotate it around and it was like an airplane tray table with a fuzzy gecko surface.

Card tapped away at the keyboard, which caused a ghostly message to cascade down the window in several languages: MONITOR LOCKED UNTIL AFTER LAUNCH. I touched one key on mine and got the same message, dim letters floating down in front of the fake seascape.

"They're just trying to make us feel comfortable," I said, but it was kind of disappointing. The window would

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normally be a clever illusion—you could play a game or read a book or whatever, but nobody could see what was on your monitor unless they were right in line with it. Sitting on your lap. From any other angle, it would look just like a window looking outside. It had something to do with polarization; the screen was actually showing two images, but you could only see one or the other.

With an hour to kill, I wasn't going to just sit and look through a fake window. I joined Barry and Elspeth in trying out the exercise machines, which were mainly for those of us going on to Mars. The others were just tourists going to the Hilton; they weren't going to be in space long enough for zero-gee to turn their bones to dry sticks and their muscles to mush.

Then we went upstairs and took a look at the zero-gee toilet. We'd sort of trained on it in Denver, in the Vomit Comet, the big ancient plane that gave us fifty seconds of zero-gee at a time—up and down, up and down, all day long. I was able to get my feet into the footholds and lower my butt into place, but that was it. I'd learn about the rest soon enough.

But not too soon. There was a regular toilet next to it, with a sign saying FOR USE UNTIL 0.25 G. So we had a few days.

The "personal hygiene" closet looked claustrophobic. Once a day you got a plastic bag with two washcloths wetted with something like rubbing alcohol. Get as clean as you can, then put the same clothes back on. It would be a little better on the *John Carter*, better but weirder—zip yourself up in a plastic bag?

The galley was on the opposite side of the room, just a microwave and a surprisingly small refrigerator, and a bunch of drawers of food and utensils. A fold-down worktable.

In the middle of both rooms, both levels, was a round table with eight seat-belted chairs, I guessed for socializing. Wouldn't it be smarter to have smaller, separate tables? Just in case there turned out to be somebody you couldn't stand the sight of?

After six months, that might be everybody, though, including the mirror.

Mustn't think negative thoughts, as Dad says. Only two weeks in this one, and then a change of scenery for five and a half months. Then a new planet.

"It's funny," I said quietly to Card, "on the boat over, I thought I could pretty well tell who were the rich people and who were the neo-Martians."

"Fancy clothes?"

"Or careful down-dressing. An ironed tee-shirt, that's a dead giveaway. With clean old jean shorts?"

"But here—"

"Yeah, and it's not just clothes. No makeup or jewelry. That has to rag them. It's going to be interesting."

"Some of the Martians are rich, too," Card said. "Barry's dad's an inventor, and he has all kinds of patents. They came out in their own plane."

"Couldn't afford a ticket?"

"Sure, right. He's got two planes, two motorcycles, two cars, just in case one breaks down. They live on the lake in Disney."

Billionaires, but still. It seemed kind of wasteful to have two of everything, even if money's not an issue. But I didn't say anything. "Barry seems like a nice enough guy."

Card shrugged. "Sure. I think he's a little scared of his dad."

"I wonder if his dad eats bull dick soup. *That's* scary." Card started giggling and so did I. Mother gave us a warning look, and that made it worse. We climbed back downstairs, snorting, and managed not to break any bones.

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8. Stop

I guess there's something to be said for launching the old way, riding three thousand tons of high explosive on a tower of fire. Dangerous but dramatic. When we took off, it was sort of like an elevator ride.

We were all strapped into our seats, probably just to keep us from wandering around. The tug above us made a whiney little noise, and there was a slight bump, and the platform below us slowly fell away. In a few seconds, you could see the big energy farm. I strained at the seatbelt, but couldn't get close enough to the "window" to see the laser and the mirror—dumb of me. It wasn't really a window; if the camera wasn't pointed at the laser, I wouldn't see it.

The noise stopped and there was another bump. "Switching over," Dr. Porter said over the intercom. A woman of few words.

The main motors were much smoother. There was a slight press of acceleration and a low hum, and in a couple of minutes we were up to our cruising speed, about 250 miles per hour.

After a couple minutes more of going straight up, we were higher than most airplanes, and you could easily see the curvature of the Earth as the Galapagos came into sight. My ears started to pop and crackle with the air pressure dropping. Upstairs, a couple of the younger kids were crying. Ears or fears?

It wasn't really anything new; we'd sat through a twelve-hour test of it at the Denver orientation, thin air with beefed-up oxygen, and everybody managed to live with it. We'll be breathing something like this for the next five years. (The high oxygen content was why we couldn't bring regular clothes—everything has to be absolutely nonflammable. And smokers have to quit.)

Little numbers in the corner of the window showed how high we were and what the gravity was. At seven or eight miles, the edge of South America was coming into view. The sky was getting darker and darker blue, and by twenty-five miles it was almost black. You could see a few stars, at least on this side. I craned my neck to see the windows behind me; the ones facing the afternoon sun were dimmed.

Soon the sky was inky black, and I shivered involuntarily. For all practical purposes, we were in outer space. Outside the elevator, you wouldn't live a minute.

That would be true in an airplane, too. I told myself not to panic. I considered taking one of the pills, but instead just closed my eyes and took a few deep breaths.

When I opened my eyes, the gravity had fallen to 0.99. I'd lost a pound already, on the Space Elevator Diet. (Money back guarantee—in one week, your weight problem will be gone!)

That was one advantage we had over the old astronauts. They went straight from one gee to nothing, and about half of them got sick. We had a week to get used to it gradually. But we did have barf bags, too.

That made me glance down to the pocket on the side of the chair. I did not count the number of bags in the stack, but rather pulled out the magazines.

We didn't get paper magazines at home. These felt funny, kind of heavy and slippery. I guess that was like the clothes, nonflammable paper.

One was the *Space Elevator News,* with a sticker on it that said "take this copy home with you." Not to Mars, I think. The others were the weekend edition of the *International Herald Tribune,* which I'd read back at the hotel (for the comics), *Time, International Photography,* and *Seventeen.*

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"God, you're reading a magazine?" Card said. "Look, South America!"

"I saw it miles ago," I said. But Earth really was starting to look like a planet, and we were only thirty miles up. I'd thought it would take a lot longer than that.

"You're free to unbelt now and walk around the carrier," Dr. Porter said. "Sometime before six o'clock, check off your dinner preference, and I'll call for you when it's ready." Doctor, chef, and waitress all in one, impressive. Though I suspected there wouldn't be much chefing involved, and I was right.

Once you got over the novelty of seeing the Earth out there, it was kind of like watching grass grow. I mean, it wasn't like low Earth orbit, where the real estate rolls along underneath you, constantly changing. I figured I could check it out once an hour, and tried the keyboard.

It worked pretty much like the console at home. Bigger picture and more detail. Out of curiosity I typed in a request for porn, and got an alphabetical menu that was a little daunting. I knew that Card would get ACCESS DENIED, which made me feel mature and privileged. (He'd probably devise a workaround in a couple of hours, but he could have it. I don't really get porn. After the first couple of times, it sort of looks like biology.)

There were a couple of thousand video and virtual channels, but unlike home, the console didn't know what I liked; there was no SUGGEST button. But I could goowiki anything.

The word "menu" started blinking in the corner of the screen, so I clicked on it. There were twelve standard choices for dinner, mostly American and Italian, with one Chinese and one Indian. Then there were ten "premium" meals, with wine, which had surcharges from $40 to $250. Some of them were French things I'd never heard of.

I clicked on beef stew, safe enough, and wondered whether Dad was going to rack up a huge bill ordering French stuff made of unspeakable parts of various animals. Mother would probably rein him in, but they both liked wine. There goes the family fortune.

You could toggle and zoom the window. I put the crosshairs on Puerto Villamil and cranked it up to 250X, the maximum. The image wobbled and vibrated, but then cleared up. I could see our hotel, and people walking around, the size of ants. With careful toggling, I found the rocky beach where I'd spent my last time actually alone.

"Hey," said a voice behind me, "that's where we met?" It was the pilot, of course, Paul Collins, crouching down so he could see what was on my screen. Was that impolite?

"Yeah, where you nailed that iguana with a rock. Or am I imagining things?"

"No, your memory is perfect. I wondered if you wanted to play some cards. We're getting a game together before anyone else claims the table upstairs."

I was flattered and a little nervous, that he had come down to find me. "Sure, if I know the game."

"Poker. Just for pennies."

"Okay. I could do that." The kids in high school had stopped playing poker with me because I always won, and they couldn't figure out how I was cheating. I wouldn't tell them my secret, which was no secret: fold unless you have something good. Most of the other kids just stayed in the game, trusting their luck, hoping to improve their hands at the last minute. That's idiotic, my Uncle Bert taught me; only one person is going to win. Make it be you, or be gone.

I got my purse out of the little suitcase and glanced at Card. He was

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wrapped up in a game or something, virtual headset on. Mental note: that way nobody can sneak up behind you and see what you're doing.

Upstairs, there were five people at the table, including Dad. "Uh oh," he said. "Might as well just give her the money."

"Come on, Dad. I don't always win."

He laughed. "Just when I'm in the game." He actually was a pretty bad poker player, not too logical for an engineer. But he played for fun, not money.

We spent a pleasant couple of hours playing Texas hold 'em and seven-card stud. I dealt five-card stud a couple of times, the purest game, but that wasn't enough action for most of them.

Dad was way ahead when I left, which was both satisfying and annoying. I learned that pilot Paul plays pretty much like me, close to the chest. If he stayed in, he had something—or he bluffed so well no one found out.

I went in with ten dollars and left with twenty. That's another thing Uncle Bert taught me: decide before you sit down how much you're going to win or lose, and stop playing at that point, no matter how long you've been in the game. You may not make any friends if you win the first two hands and leave. But poker's not about making friends, he said.

The gravity was down to 0.95 when I went back to my chair, and I could almost tell the difference. It was a funny feeling like "Where did I leave my purse?"

I could just see North America coming up over the edge of the world. Zoomed in on Mexico City, a huge sprawl of places you probably wouldn't like to visit without an armed guard.

Card was still in virtual, doing something with aliens or busty blondes. I put on the helmet myself and chinned through some of the menu. Nothing that really fascinated me. Curious, I spent a few minutes in "Roman Games: Caligula," but it was loud and gory beyond belief. Settled into "midnight warm ocean calm," and set the timer for six, then watched the southern sky, the beautiful Cross and Magellanic Clouds, roll left and right as the small boat bobbed in the current. I fell asleep for what seemed like about one second, and the chime went off.

I unlocked the helmet and instantly wished I was back on the calm sea. Someone had heard the dinner bell and puked. They couldn't wait for zero-gee? There went my appetite.

After a few minutes there was a double chime from the monitor and a little food icon, a plate with wavy lines of steam, started blinking in the corner. I went upstairs to get it, hoping I could eat up there.

I was the second person up the ladder, and there was a short line forming behind me. They said they would call ten people at a time for dinner, I guess at random.

There were ten white plastic boxes on the galley table, with our seat numbers. I grabbed mine and snagged a place at the center table, across from the rich kid, Barry.

He had the same thing I did, a plate with depressions for beef stew with a hard biscuit, a stack of small cooked carrots, and a pile of peas, all under plastic. Everything was hot in the middle and cool on the outside.

"I guess we can say good-bye to normal food," he said, and I wondered what dinner normally was to him. Linen and crystal, sumptuous gourmet food dished out by servants? "Water boils at 170 degrees, at this pressure," he continued. "It doesn't get hot enough to cook things properly."

"Yeah, I read about coffee and tea."

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All instant. The stew was kind of chewy and dry. The carrots glowed radioactively and the peas were a lurid bright green and tasted half raw.

Funny, the peas started to roll around on their own. A couple jumped off the plate. There was a low moan that seemed to come from everywhere.

"What the hell?" Barry said, and started to stand up.

"Please remain seated," Dr. Porter shouted over the sound. The floor and walls were vibrating. "If you're not in your assigned seat, don't return to it until the climber stops."

"Stops?" he said. "What are we stopping for?"

"Probably not to pick up new passengers," I said, but my voice cracked with fear.

Dr. Porter was standing with her feet in stirrup-like restraints, her head inside a VR helmet, her hands on controls.

"There isn't any danger," her muffled voice said. "The climber will stop for a short time while the ribbon repair vehicle separates to repair a micrometeorite hole." That was the squat machine on top of the climber. It separated with a clang and a lurch; we swayed a little.

I swallowed hard. So we were stuck here until that thing stitched up the hole in the tape. If it broke, we'd shortly become a meteorite ourselves. Or a meteor, technically, if we burned up before we hit the ground.

"I heard it happens about every third or fourth flight," Barry said.

I'd read that, too, but it hadn't occurred to me that it would be scary. Stop, repair the track, move on. I swallowed again and shook my head hard. Two children were crying and someone was retching.

"Are you all right?" Barry asked, a quaver in his voice.

"Will be," I said through clenched teeth.

"How about them Gators?"

"What? Are you insane?"

"You said you live in Gainesville," he said defensively.

"Don't follow football." An admission that could get me burned at the stake in some quarters.

"Me, neither." He paused. "You win at poker?"

"A thousand," I said. "I mean ten bucks. A thousand pennies."

"Might as well be dollars. Nothing to spend it on."

Interesting thing for him to say. "You could buy stuff when we stop at the Hilton."

"Yeah, but you couldn't carry it with you. Unless you have less than ten kilograms."

Maybe I should've saved a few ounces, bring back an Orbit Hilton T-shirt. Be the only one on the block.

The pilot Collins sat down next to Barry. "Thrills and chills," he said.

"Routine stuff, right?" Barry said.

He paused a moment, and said, "Sure."

"You've seen this happen before?" I said.

"In fact, no. But I haven't ridden the elevator that many times," He looked past me, to where Dr. Porter was doing mysterious things with the controls.

"Paul . . . you're more scared than I am."

He settled back into the chair, as if trying to look relaxed. "I'm just not used to not being in control. This *is* routine," he said to Barry. "It's just not my routine. I'm sure Porter has everything under control."

His face said that he wasn't sure.

"You're free to walk around now," Dr. Porter said, her head still hidden. (I suppose pilots can walk around all they want.) "We'll be done here in less than an hour. You should be in your seats when we start up again."

Barry relaxed a little at that, and turned his attention back to dinner.

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Paul didn't relax. He stood up slowly and took the vial of white pills from his pocket. He shook out two into his hand and headed for the galley, to pick up a squeeze-bottle of water. He took the pills and went back to his seat.

Barry hadn't seen that, his back to the galley. "You're not eating," he said.

"Yeah." I took a small bite of the beef, but it was like chewing on cardboard. Hard to swallow. "You know, I'm not all that hungry. I'll save it for later." I pressed the plastic back down over the top and went over to the galley.

The refrigerator wouldn't open—not keyed to my thumbprint—so I took the plate and a bottle of water back down to my seat.

Card was reading a magazine. "That *food?*"

"Mine, el Morono. Wait your turn." I slid it under my seat but kept the water bottle. The pilot had taken two pills; I took three.

"What, you scared?"

"Good time to take a nap." I resisted telling him that if the Mars pilot was scared, I could be scared, too, thank you very much.

I pulled the light blanket over me. It fastened automatically on the other side, a kind of loose cocoon for zero-gee.

I reached for the VR helmet, but it was locked, a little red light glowing. Making sure everyone could hear emergency announcements, I supposed. Like "The ribbon has broken; everybody take a deep breath and pray like hell."

After about a minute, the pills were starting to drag my eyelids down, even though the anxiety, adrenaline, was trying to keep me awake. Finally, the pills won.

9. Losing weight

I slept about ten hours. When I woke up it was right at midnight; the elevator restarting hadn't awakened me. The window said we'd gone 2250 miles and we were at 0.41 gee. You could see the whole Earth as a big globe. I took the pen out of my pocket and dropped it experimentally. It seemed to hesitate before falling, and then drifted down in no hurry.

It's one thing to see that on the cube, but quite another to have it happening in your own world. We were in space, no doubt about it.

I unbuckled and pointed myself toward the john. Walking felt strange, as if I was full of helium or something. It was actually an odd combination of energy and light-headedness, not completely pleasant. Partly the gravity and partly the white pills, I supposed.

I went up the ladder with no effort, barely touching the rungs. You could learn to like this—though we knew what toll it eventually would take.

Probably the last time I'd sit on a regular toilet. I should ask the machine when we were due to hit a quarter-gee and switch to the gruesome one. Go join the line just before. Or not. I'd be living with the sucking thing for months; one day early or late wouldn't mean anything.

My parents were both zipped up, asleep. Several people were snoring; guess I'd have to get used to that.

There were four people I didn't know talking quietly at the table. Downstairs, two people were playing chess while two others watched. I took the copy of *Seventeen* from my chair and walked over to the bike machine. Might as well get started on saving my bones.

The machine was set on a hill-climbing program, but I really didn't want to be the first person aboard to work up a sweat. So I clicked it to "easy" and pedaled along while reading the magazine.

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So little of it was going to be useful or even meaningful for the next five years. Hot fashion tips! ("Get used to blue jumpsuits.") Lose that winter flab! ("Don't eat the space crap they put in front of you.") How to communicate with your boyfriend! ("E-mail him from 250 million miles away.")

I hadn't really had a boyfriend since Sean, more than a year ago. Knowing that I was going to be on another planet for five years put a damper on that.

It wasn't that simple. The thing with Sean, the way he left, hurt me badly enough that the idea of leaving the planet was pretty attractive. No love life, none of that kind of pain.

Did that make me cold? I should have fallen helplessly in love with someone and pined away for him constantly, bursting into tears whenever I saw the Earth rise over the morning horizon. Or did I see that in a bad movie?

There weren't any obviously great prospects aboard the carrier. They might start to look better as the years stretched on.

I did start to cry a little and the tears just stayed in my eyes. Not enough gravity for them to roll down your cheek. After pedaling blind for a minute, I wiped my eyes on a nonabsorbent sleeve and cranked on. There was an article on Sal the Sal, a hot new cube star that everyone but me had heard of; I decided to read every word of that and then quit.

He was so sag beyond sag it was disgusting. Fascinating, too. Like if you can care little enough about everything you automatically become famous. You ask him for an autograph and he pulls out a rubber stamp, and everybody just comes because it's so sag. Forgive me for not joining in. I bet Card knows his birth date and favorite color.

Pedaling through all that responsible journalism did put me on the verge of sweating, so I quit and went back to my seat. Card had put aside the helmet and was doing a word puzzle.

"Card," I asked, "what's Sal the Sal's favorite color?"

He didn't even look up. "Everybody knows it's black. Makes him look 190 pounds instead of 200."

Fair enough. I handed him the magazine. "Article on him if you want to read it."

He grunted thanks. "Five letter word meaning 'courage'? Second letter P, last letter K?"

I thought for a couple of seconds. "Spunk."

He frowned. "You sure?"

"It's old fashioned." Made me think of the pilot, who seemed to have "spunk," Space Force and all, but was scared by an elevator incident.

I sat down and buckled in and got scared all over again myself. He had a point, after all. Accidents could happen on the way to Mars, but nothing that would send us hurtling to a flaming death in Earth's atmosphere.

Don't be a drama queen, Dad would say. But the idea of dying that way made my eyes feel hot and dry.

10. Social climbing

The fear faded as we fell into routine, climbing up toward the Hilton midpoint. We grew imperceptibly lighter every hour, obviously so day by day. By the sixth day, we'd lost 90 percent of our gravity. You could go upstairs without touching the ladder, or cross the room with a single step. There were a lot of collisions, getting used to that.

It was getting close to what we'd live with on the way to Mars. We wore gecko slippers that lightly stuck to the floor surface, and there were gray spots on the wall where they would also adhere.

The zero-gee toilet wasn't bad once you got used to it. It uses flowing air

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instead of water and you have to pee into a kind of funnel, which is different. The crapper is only four inches in diameter and it uses a little camera to make sure you're centered. A little less attractive than my yearbook picture.

I hope Dr. Porter gets paid really well. Some of the little ones didn't climb the learning curve too swiftly, and she had to clean up after them.

It didn't help the flavor of the food any to know where the water came from. Get used to the idea or starve, though. I found three meals on the menu I could eat without shuddering.

I mostly hung around with Elspeth and Barry and Kaimei, a Chinese girl a year younger than me. She was born in China but grew up, bilingual and sort of bicultural, in San Francisco. She was a dancer there, small and muscular, and you could tell by the way she moved in low gravity that she was going to love zero-gee.

The smaller kids were going detroit with the light gravity. Dr. Porter set hours for playtime and tried to enforce them by restraining offenders in their seats. Then, of course, they'd have to go to the bathroom, and wouldn't go quietly. She looked like she was going to be glad to send them on to Mars or leave them at the Hilton.

I would, too, in her place. Instead, I get to go along with them, at least the ones who were ten and older. After we left the tourists at the Hilton, we wouldn't have anybody under ten aboard—if there were any small children in the Mars colony, they'd have to be born there.

Luckily, the two worst offenders were brother brats who were getting off at the Hilton. Eighty grand seems like more than they were worth, and you'd think their parents would have had a better time without them. Maybe they couldn't find a babysitter for two weeks. (Hell, I'd do it for less than eighty grand. But only if they let me use handcuffs and gags.)

We weren't supposed to play any throwing and catching games, for obvious reasons, but Card had a rubber ball, and out of boredom we patted it back and forth in the short space between us. Of course it went in almost ruler-straight lines, how exciting, even when he tried to put English on it—he needed speed and a floor or wall to bounce off, and a little bit of space for the thing to bounce around in. But even he was smart enough not to try anything that would provoke Dr. Frankenstein's wrath.

Elspeth and I signed up for the exercise machines at the same time, and chatted and panted together. I was in slightly better shape, from fencing team and swimming three times a week. No swimming pools on Mars, this century. Probably no swords to fence with, either. (The John Carter fictional character the ship was named after used a sword, I guess when his ray gun ran out of batteries. Maybe we could start the solar system's first low-gravity fencing team. Then if the Martians *did* show up, we could fight them with something sharper than our wits.)

Actually, Elspeth was better than me on the stair-step machine, since in our flat Florida city you almost never encounter stairs. Ten minutes on that machine gave me pains in muscles I didn't know I owned. But I could pedal or row all day.

Then we took turns in the "privacy module," which they ought to just call a closet, next to the toilet, for our daily dry shower. Moist, actually; you had two throwaway towelettes moistened with something like rubbing alcohol—one of them for the "pits and naughty bits," as Elspeth said, and the other for your face and the rest of your body. Then a small reusable towel for rubdown. Meanwhile your jumpsuit is rolling around in a water-

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less washing machine, getting refreshed by hot air, ultrasound, and ultraviolet light. It comes out warm and soft and only smelling slightly of sweat. Not all of it your own, though that could be my imagination.

I fantasized about diving into the deep end of the city pool and holding my breath for as long as I could.

Six hours before we were due at the Hilton, we were asked to stick our heads into the helmets for "orientation," which was more of a sales job than anything else. Why? They already had everybody's money.

The Hilton had a large central area that stayed zero-gee, the "Space Room," with padded walls and a kind of oversized jungle gym. A pair of trampolines on opposite walls, so you could bounce back and forth, spinning, which looked like fun.

People didn't stay there, though; the actual rooms were in two doughnut-shaped structures that spun, for artificial gravity, around the zero-gee area. The two levels were 0.3g and 0.7g.

The orientation didn't mention it, but I knew that about half of the low-gee rooms housed permanent residents, rich old people whose hearts couldn't take Earth gravity anymore. All of the people in the presentation were young and energetic, and vaguely rich-looking in their tailored Hilton jumpsuits, I guess no different from ours except for the tailoring and choice of colors.

We would stop there for four hours, and could explore the hotel for two of them. We were all looking forward to the change of scenery.

"Don't use the Hilton bathrooms unless you absolutely have to," Dr. Porter said. "We want to keep that water in our system. Feel free to drink all of theirs you can hold."

The four hours went by pretty quickly. Basically seeing how rich folks live without too much gravity. Most of them looked pretty awful, cadaverous with bright smiles. We looked at the prices at Conrad's Café, and could see why they might not want to eat too much.

We did play around a bit in the weightless gym area. Elspeth and I played catch with her little sister Davina, who obediently curled into a ball. Spinning her gave us all the giggles, but we had to stop before she got totally dizzy. She looked a little green as she unfolded, but I think was happy for the small adventure and the attention.

I did a few bounces on the pair of trampolines, managing four before I got off-target and hit the wall. Card was good at it, but quit after eight or so, rather than hog it. I suppose two people could use it at once if they were really good. Only once if they weren't. Ouch.

The interesting thing about the jungle gym was gliding through it, rather than climbing on it. Launch yourself from the wall and try to wriggle your way through without touching the bars. The trick is starting slow and planning ahead—a demanding skill that will be oh-so-useful if I ever find myself having to thread through a jungle gym, running from Martians.

Dr. Porter had found a whistle somewhere. She called us to the corridor opening and counted noses, then told us to stay put while she went off in search of a missing couple. They were probably in Conrad's Café guzzling hundred-dollar martinis.

I mentioned that to Card and said there wouldn't be any vodka on Mars—and he bet me a hundred bucks there would be. I decided not to take the bet. Seventy-five engineers would find a way.

The missing duo appeared in the elevator and we crawled back home to wait in line for the john. The carrier seemed cramped.

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The *John Carter* would be about three times as big, but nothing like the Hilton. After that, though, a whole planet to ourselves.

11. Up and out

The trip from the Hilton out to the end of the tether was more subdued than the first leg. Half as many of us and all of us headed for Mars, except Dr. Porter.

We spent a lot of time sitting around in small groups talking, some about Mars but mostly about who we were and where we came from.

Most of us were from the States, Canada, and Great Britain, because the lottery was based on the amount of funding each country had put into the Mars Project. There were families from Russia and France. The flight following ours, in eighteen months, would have German, Australian, and Japanese families. A regular United Nations, except that everybody spoke English.

My mother talked to the French family in French, to stay in practice; I think some disapproved, as if it was a conspiracy. But they were fast friends by the time we got to the ship. The mother, Jac, was back-up pilot as well as a chemical engineer. I didn't have much to do with their boy Auguste, a little younger than Card. His dad Greg was amusing, though. He'd brought a small guitar along, which he played softly, expertly.

The Russians kept to themselves but were easy enough to get along with. The boy, Yuri, was also a musician. He had a folding keyboard but evidently was shy about playing for others. He would put on earphones and play for hours, from memory or improvising, or reading off the screen. Only a little younger than me, but not too social.

Our doctor on the way to Mars would be Alphonzo Jefferson, who was also a scientist specializing in the immune system; his wife Mary was also a life scientist. Their daughter Belle was about ten, son Oscar maybe two years older.

The Manchester family were from Toronto, the parents both areologists. The kids, Michael and Susan, were ten-year-old twins I hadn't gotten to know. I didn't know Murray and Roberta Parienza well, either, Californians about our age (Murray the younger) whose parents came from Mexico, an astronomer and a chemist.

So our little UN among the younger generation was two Latins, a Russian, two African-Americans, two Israelis, and a Chinese-American, slightly outnumbering us plain white-bread Americans.

We'd all be going to school via VR and e-mail during the six-month flight, though we started going on different days and of course would have class at different times, spread out over eleven time zones. If Yuri had a class at nine in the morning, that would be ten for Davina and Elspeth, eleven for Auguste, five in the afternoon for us Floridians, and eight at night for the Californians. It was going to make the social calendar a little complicated. As if there was anything to do.

Meanwhile, we could enjoy the extra elbow room we got from dumping off the nine tourists. I moved upstairs to sit next to Elspeth, which put Roberta on my right. Dr. Porter rolled her eyes at three teenage females in a row, and told us to keep the noise down or she'd split us up. That wasn't exactly fair, since the little kids were the real noisemakers, and besides, most of our parents were on the second level, too.

But you had to have some sympathy for her. The littlest ones were always testing her to see how far they could go before she applied the ultimate punishment: locked in the seat

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next to your parents with the VR turned off for X hours. She couldn't hit them—some parents wouldn't mind, but others would have a fit—and she couldn't exactly make them go outside to play, though if she did that once, the others might calm down.

(It was no small trick to get a recalcitrant child back to its place in zero-gee. They'd push off and fly away giggling while she stalked after them with her gecko slippers. Hard to corner somebody in a round room. The parents or other adults usually had to help.)

What finally worked was escalating punishment. Each time she had to strap a kid in, she added fifteen minutes' VR deprivation to *everyone's* next punishment, no exceptions. At ten, they were old enough to do the math and started policing themselves—and behaving themselves, a small miracle.

We went a little faster on the second half, and it would've taken only four and a half days, except we had to stop again while the robot repaired a tear in the tape ahead.

I had a vague memory of watching the news when they started building the two Mars ships eleven years ago. They'd taken the fuel tanks from the old pre-Space Elevator cargo shuttles, cut them up, and rearranged the parts. The first one, the *Carl Sagan,* was assembled in Low Earth Orbit; the second up at GEO, where the Hilton is now. I guess the Elevator wasn't available for the first. Anyhow, they both took a long crawl up here, spiraling slowly up with some sort of solar power engine. The first one took off while they were still working on ours.

The *Sagan* had made two round trips, and was on its third, in orbit around Mars, now. Ours had only been once, but at least we knew that it worked.

Of course a spaceship doesn't have to be streamlined to work in outer space, with no air to resist, but the fuel tanks these were built from had gone through the atmosphere, and so they looked kind of like a hokey rocketship from an old twentieth century movie, though with funny-looking arms sticking out on the left and right, with the knobs we'd be living in.

We could see the *John Carter* a couple of hours before we got there, at least as a highly magnified blob. Slowly it took shape, the stubby rocketship with the two pods rotating around it, once each ten seconds.

The carrier slowed down for the last couple of minutes. Strapped in, we watched the spaceship draw closer and closer.

It wasn't too impressive, only ninety feet long, unpainted except for the white front quarter, the streamlined lander. We were going in through the side of that, a crawl tunnel like we'd used for the Hilton.

The carrier came to a stop and Dr. Porter and the pilot Paul put on space suits to go check things out. They came back in a few minutes and said things were fine, but a little cold. The air that came through the open airlock door was wintry—colder than it ever gets at home. Paul said not to worry; we'd warm it up.

They opened the storage area under the exercise machines, and we started carrying things over. Not as easy as it might seem, in zero-gee. Nothing had weight—if you let go of it, it wouldn't fall—but everything had inertia. If you wanted to move a piano, you'd have to get behind it (with your feet anchored) and shove.

We didn't have a piano, except for Yuri's little folding one, but we did have some pretty heavy boxes, a lot of it food and water for the trip. "Starter" water, which would be recycled. I'd almost gotten resigned to the

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fact that a little bit of every drink I took had gone through my brother at least once.

You could see your breath. I had goosebumps and my teeth started chattering. Barry and his parents were the same way, fellow Floridians. My parents and Card seemed to have some Eskimo blood.

A lot of the stuff we stored in the Mars lander, under Paul's supervision. Some of it went into A or B, the pods where we'd be living.

That was sort of like the Hilton in miniature. There was a relatively large zero-gee room, a cylinder twenty-two feet long by twenty-seven feet wide. On opposite sides there were two four-foot holes, A and B, with ladders going down. No elevators.

Of course we were all pretty good with zero-gee, though there were a few bumped heads.

I couldn't get warm. Fortunately, one of the things I delivered was a bundle of blankets for "Sleeping A." I was A-8, so I liberated one of the blankets and wrapped it around myself.

Saying good-bye to Dr. Porter was more emotional than I would have thought. Tears sticking like glue to your eyelashes. She hugged me and whispered, "Take care of Card. You'll love him soon enough."

She went back to the carrier and the airlock closed. Paul warned us we all had thirty minutes to use the toilet, and then we'd be strapped in for almost two hours. I didn't really need to go, but might as well be prudent, and I was mildly curious about what I'd be putting up with for the next three months. I got at the end of the line and asked my reader for a random story. It was an amusing thing from France a million years ago, about a necklace.

The zero-gee toilet was the same as the carrier's, but without the little camera. I didn't miss it, nor did I miss the target.

The Mars lander was set up sort of like an airplane, two rows of seats separated by an aisle, but with the pilot and all his gear up front. We strapped in and waited for twenty minutes or so. Then the engine grumbled and roared, and for six minutes we were heavier than we'd been on Earth. It was hard to breathe, and might have been scary if you didn't know how long it was going to last. But a clock counted down on the screen in front.

The blanket I'd wrapped around me had a crease that pressed into my back like a dull knife. I tried to pull it smooth, but my arms were like lead, and I gave up.

Most of the speed we needed for getting to Mars was "free"—when we left the high orbit at the end of the Space Elevator, we were like a stone thrown from an old-fashioned sling, or a bit of mud flung from a bicycle tire. Two weeks of relatively slow crawling up built up into one big boost, from the orbit of Earth to the orbit of Mars.

We had to stay strapped in because there would be course corrections, all automatic. The ship studied our progress and then pointed in different directions and made small bursts of thrust.

It was only a little more than an hour when Paul gave us the all-clear to go explore the ship and get a bite to eat.

Compared to the Space Elevator carrier, it was huge. From the lander, you go into the zero-gee room, which was about three times the size of our living room at home. The circular wall was all storage lockers that opened with the touch of a recessed button, no handles sticking out to snag you.

You climb backward down the ladder, in a four-foot-wide tunnel, to get to the living areas, A or B. Both pods

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were laid out the same. The first level, for sleeping, had the least gravity, close to what we'd have on Mars. Then there was the work/study area, basically one continuous desk around the wall, with moveable partitions and maybe twenty viewscreens. They were set up as fake windows, like the carrier's "default mode"—thankfully not spinning around six times a minute.

The bottom level was the galley and recreation area. I felt heavy there, after all the zero-gee, but it was only about half Earth's gravity, or 1.7 times what we'd have on Mars, the next five years.

It had a stationary bicycle and a rowing machine with sign-up rosters. You were supposed to do an hour a day on them. I took seven A.M., since eight and nine were already spoken for.

Elspeth and Davina found me down there, and we had the first of about two hundred lunches aboard the good ship *John Carter*. A tolerable chicken salad sandwich with hot peas and carrots. Card showed up and had the same. He made a face at the vegetables, but ate them. We'd been warned to eat everything in front of us. The ship wasn't carrying snacks. If you get hungry between meals, you just have to be hungry. (I suspected we'd find ways around that.)

It was a lot more roomy than you'd expect a spaceship to be, which was a provision for disaster. If something went wrong and one of the pods became uninhabitable, all thirty-three of us could move into the other pod. Then if something happened to *it,* I guess we could all move into the zero-gee room and the lander. I don't know what we'd eat, though. Each other. ("It's your turn now, Card. Be a good boy and take your pill.")

I sat down at one of the study stations and typed in my name and gave it a thumbprint. I had a few letters from friends and a big one from the University of Maryland. That was my "orientation package," though actual classes wouldn't start for another week.

It was very handy—advice about where to get a parking sticker, dormitory hours, location of emergency phones and all. More useful was a list of my class hours and their virtual-reality program numbers, so I could be in class after a fashion.

It was a little more complicated for me than for the kids actually on campus. Up in the right-hand corner of the screen were UT, universal time, and TL, time lag. The time lag now, the time it took for a signal to get from me to the classroom, was only 0.27 of a second. By the time we got to Mars, it could be as much as twenty-five minutes (or as little as seven, depending on the distance between the planets). So if I asked the professor a question at what was to me the beginning of the fifty-minute class, he'd already be halfway through, Earth time. He'd get my question while everybody else was packing up their books, and his answer would get to me twenty-five minutes after class was over.

Actually, it would be even more complicated once we were on Mars Time, since the day is forty minutes longer. But I didn't have to worry about that until we got halfway there, and switched.

Ship time was Universal Time, until we hit the halfway point, which put us on the same schedule as people living just up-river from London, which I guess had made sense when they were planning things on Earth. Why not go straight to Mars time? Whatever, I got a few pages into the college catalog and my body said sleep, even if it was only two, 1400, to the folks in Merrie Olde Englande. I dragged my blanket up to the light-gee sleeping floor and wrapped my-

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self up in it, and slept till the dinner bell.

12. Trouble

The first week or two we were under way, I was asleep as much as awake, or more, which got Mother worried. She had me go talk to Dr. Jefferson, who asked me whether I felt depressed, and I'm afraid my response was a little loud and emotional. I mean, no, I wasn't depressed; I was just imprisoned and hurtling off to some uncertain future, probably to die before I was legally an adult, and I asked him aren't *you* depressed?

He smiled and nodded (maybe not "yes"), and gave me a light hug, the big black bear, which might have made me slightly telepathic. It wasn't so much the abstract danger. I was really upset at not being able to concentrate, falling asleep over my college prep work . . . but what was that, compared to being the only doctor aboard, waiting for someone to need an appendix out, or even a brain tumor? Or just pulling a tooth or looking up someone's ass with an ass-o-scope. He only had to take care of thirty-two of us, but anything could happen, and he was responsible for our life or death.

He probably had a suitcase full of pills for depression, and said he'd give me some if I needed them, but first he wanted me to keep a personal record for a week—how many hours asleep and awake; when I lost my temper or felt like crying. After a week, we would talk about it.

He said he was no psychologist, but that seemed to work, maybe because I wanted to impress him, or reassure him. After a week I was sleeping eight hours and pretty much awake the rest of the time. And I was undramatically less sure that space wanted to kill us all, especially me.

All of us between ten and twenty had "jobs," which is to say chores. Mine was easy, cleaning the galley after meals, a lot less mess than the kitchen at home, with nothing actually cooked. Card had to clean the shower, which I suppose enriched his fantasy life.

Everybody spent thirty minutes a day learning about Mars. That was mostly boring reinforcement of stuff we already knew, or should have known. I tolerated the half-hour until regular classes started, and really just sort of thought about other things while it droned on. Nobody was testing me on Mars facts, but I had exams in history and math and philosophy.

Of course, Mars would test me on Mars. I knew that and didn't think about it.

School was absorbing but tiring. Part of it was that every professor was a kind of a star—I suppose every subject, every department, picked its most dramatic teacher for the VR classes, but the net result was almost like being yelled at—"This led to the Hundred Years War—how long do you think that war LASTED?" "Look where potassium and sodium are on the Periodic Table—what does THAT suggest to you?" Socrates and Plato getting it on, more than I wanted to know about student-teacher relationships. And could I have just one subject that's not supposed to be the most important thing in the world? I should've taken plumbing.

Actually, the stories and plays in the literature course all promise to be interesting, no surprise, since that has always been the most enjoyable part of school. It doesn't have any exams, either, just essays, which suits me.

I didn't want to major in lit, though. I couldn't see myself as a teacher, and I don't think anybody else gets paid to read the stuff for a living. I didn't have to choose a major for a couple of years. Maybe I could become the first Martian veterinarian.

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Wait for some animals to show up.

Something I would never have predicted was that the virtual-reality classrooms smelled more real than our real spaceship. If someone was chewing gum or eating peanuts near where you were "sitting," it was really intense. Our air on board the *John Carter* was thin and it circulated well. When you peeled the plastic off a meal, you could smell it for a few seconds, but then it was pretty much gone, and a lot of the flavor as well.

Roberta and Yuri were also starting college, though in Yuri's case it was more like a practical conservatory. Most of his courses were music. (I wondered how the time lag was going to affect that. When I suffered through piano lessons in fifth and sixth grade, I cringed in anticipation of the *whack-whack-whack* Ms. Varleman would make with her stick on the side of the piano whenever I lagged behind. I might have liked learning piano if the teacher was twenty-five minutes away!)

My life settled into a fairly busy routine. Classes and homework and chores and exercise periods. A blood test said I was losing calcium and so my forty-five-minute exercise requirement went up to ninety minutes; two hours if I could schedule it. Hard to beat the combination—what else is both tiring and boring for two hours?

Actually, I could read or do limited VR while I was biking or rowing. It's kind of fun to row down the streets of New York or Paris. You do get run over a lot, but you get used to it.

Routine or no routine, the possibility of disaster is always in the back of your mind. But you always think in terms of something dramatic, like an explosion onboard or a huge meteoroid collision. When it did happen, nobody knew but the pilot.

We had sprung a leak. On the cube, that would be air shrieking out, or at least whistling or hissing. Which would be kind of nice, because then you could find it and put a piece of duct tape over it. Ours was seeping out silently, and we didn't have too long to find the problem.

Paul put a message up on every screen, a strobing red exclamation point followed by WE ARE LOSING AIR! That got almost everybody's attention.

We were losing about a half of one percent a day. We were still four months away from Mars, so the oxygen would be getting pretty thin if we didn't fix it.

It was easy enough to find the general area of the leak. Every part of the ship could be closed off in case of emergency, so Paul just had us close up each section of the ship, one at a time, for about two hours. That was long enough to tell whether the pressure was still dropping.

First we closed off Pod A, where I lived, and I was relieved to find it wasn't there. It wasn't in Pod B, either, nor the solar storm radiation shelter. It wasn't the zero-gee center room, which basically left the lander. That was bad news. As well as being the vehicle that would get us to the Martian surface, that was where all the pilot's instrumentation and controls were. We couldn't very well just close it off for the next three months and then refill it with air for the trip down.

In fact, though, we wound up doing a version of that. First Paul tried to find the leak with a "punk"—not like granddad's ancient music, but a stick of something that smoldered. The smoke should have led us to the leak. It didn't, though, which meant we didn't have a simple thing like a meteor ("micrometeoroid," technically) hole. A seam or something was leaking, maybe the port that the pilot looked through, or the airlock to the outside.

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Of course there was also an inside airlock, between the lander and the rest of the ship, and that gave us the solution. Paul didn't have to live in the lander; he just checked things every now and then. In fact, he could monitor all the instruments with a laptop thing, from anywhere.

So although it made him nervous—not being able to run things from the pilot's chair—we closed off the lander and just let it leak. If Paul had to go in there every day or two, he could put on a spacesuit and go through the airlock.

It made some of us nervous, too, like being cargo in a ship without a rudder. Okay, that was irrational. But we'd already had one emergency. What if the next one called for immediate action, but Paul had to suit up, waiting for the airlock to cycle through? That took about two minutes.

In two minutes we covered almost a thousand miles. A lot could happen. And there weren't any spacesuits for the rest of us.

13. Virtual friends and foes

I was not the most popular girl in my classes—I wasn't *in* class at all, of course, except as a face in a cube. As the time delay grew longer, it became impossible for me to respond in real time to what was going on. So if I had questions to ask, I had to time it so I was asking them at the beginning of class the next day.

That's a prescription for making yourself a tiresome know-it-all bitch. I had all day to think about the questions and look stuff up. So I was always thoughtful and relevant and a tiresome know-it-all bitch. Of course it didn't help at all that I was younger than most and a brave pioneer headed for another planet. The novelty of that wore off real fast.

Card wasn't having any such problems. But he already knew most of his classmates, some of them since grade school, and was more social anyhow. I've usually been the youngest in class, and the brain.

I'm also a little behind my classmates socially, or a lot behind. I had male friends but didn't date much. Still a virgin, technically, and when I'm around couples who obviously aren't, I feel like I'm wearing a sign proclaiming that fact.

That raised an interesting possibility. I never could see myself still a virgin five years from now. I might wind up being the first girl to lose her virginity on Mars—or on any other planet at all. Maybe some day they'd put up a plaque: "In this storage room on such-and-such a date . . ."

But with whom? I couldn't imagine Yuri tearing himself away from the keyboard long enough to get involved. Oscar and Murray seemed like such kids, though once they're college age that may be different.

There would be plenty of older men on Mars, who I'm sure would be glad to overlook my personality defects and lack of prominent secondary sexual characteristics. But thinking of an older man that way made me cringe.

Well, the next two ships would also be made up of families. Maybe I'd meet some nice Aussie or a guy from Japan or China. We could settle down on Mars and raise a bunch of weird children who ate calcium like candy and grew to be eight feet tall. Well, maybe not for a few generations.

Nobody talked about it much, but the idea of putting a breeding population of young men and women on Mars gave this project some of its urgency. After Calcutta and Gehenna, any nightmare was possible.

The mind veers away from it, but how much more sophisticated would the warriors have to be, to make the whole world into Gehenna? How much crazier would they have to be

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to want it?

We got into that once on the climber, Dad doubting that it would be physically possible, at least for a long time, and also doubting that the most fanatical terrorist would be *that* crazy. To hate not just his enemies, but all of humanity, that much. Mother nodded, but she had her bland patient look: I could argue, but won't. Card was kind of bored, familiar as he was with playing doomsday scenarios. Sometimes I think that nothing is really real to him, so why should doomsday be any different?

Time started passing really fast once we were settled into school, and most of our parents into their various research projects. It was more comfortable than you would expect, with all of us crammed into a space the size of a poverty-level tenement—but the parents and kids seemed to be giving each other more respect, more space.

Even the little kids calmed down. Mary Jefferson taught all four grades at once, in a partitioned-off part of B galley, and when they weren't in school or exercising, they played down in the zero-gee room, pretty far from anyone's work area, and usually respected the no-screaming rule.

(The idea of "Spaceship Earth" is such an old cliché that Granddad makes a face at it. But being constantly aware that we were isolated, surrounded by space, did seem to make us more considerate of one another. So if Earth is just a bigger ship, why couldn't they learn to be as virtuous as we are? Maybe they don't choose their crew carefully enough.)

Roberta was having more trouble than I was, making the transition from high school to college. For one thing, she's very social, and used to studying together with other girls and boys. That wasn't really possible here, with us all going to different schools. Besides, she'd tested into advanced math and chemistry, while I was starting with lowly calculus and general physical science. We both had English lit and philosophy, but of course with different textbooks.

Mother sometimes worried about my tendency to be a loner, but it turns out to be an advantage, studying when your classmates are millions of miles away.

I did coordinate my study hours with Roberta, so we were both doing lit and philosophy homework at the same time, and she helped me over some humps in the math course. We also had exercise and meal hours together most of the time, along with Elspeth.

It was not much like anybody's picture of college life. No wicked fraternity parties, no experimenting with drugs and sex and finding out how much beer you can hold before overflowing. Maybe this whole Mars thing was a ruse my parents made up to keep me off campus. My education was going to be so incomplete!

That was actually a part of college I hadn't been looking forward to. Not "growing up too fast," as Mother repeatedly said, but looking foolish because I didn't know how to act when confronted with temptation. When do you politely decline and when should you be indignant?

And when should you say yes?

14. Midway

At the midpoint of our voyage, Mars was a bright yellow beacon in front of us, Earth a bright blue star behind. It was an occasion to party, and the Mars Corporation had actually allotted a few kilograms' mass for a large plastic bottle of Remy Martin cognac for that purpose.

Since several of the adults didn't drink, it proved enough to get the rest of them about as intoxicated as they wanted to be, or perhaps a little more. Like me.

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We joked about the drinking age between planets and my parents shrugged. Since there was no other alcohol aboard ship, I wasn't likely to become a drunkard. Which doesn't mean I couldn't get into trouble.

Paul had only one drink, mixed with water—the curse of being captain, he said wryly—but I had three before my parents went to bed, and maybe two afterward. It lowered my inhibitions, but I suppose I wanted them lowered.

The drinks were served in the galley, where there was gravity to keep the booze in the glasses, but some of us moved into the zero-gee area to dance. Pretty strange, dancing without a floor. It was all kind of free-style and rambunctious. We took turns asking the ship for music. A lot of it was old, jazz and ska and waterbug, or ancient like waltzes and rock, but there was plenty of city and sag.

Paul and I danced for a while, usually with each other, and I guess I started feeling glamorous, or at least sexy, dominating the captain's attentions. Not that there was much unmarried competition.

The zero-gee room goes to nightlight from midnight till six, conserving power and giving people a reasonably private, or at least anonymous, place to have sex—or romance, but I don't think much of that was going on. There was no real privacy in the sleeping quarters, just a thin partition, which didn't prevent some people from embarrassing the rest of us. But most couples waited and met at one dark end or the other of the zero-gee room.

At midnight the only others in the zero-gee room were the Manchesters, who left us alone after a bit of obvious yawning and stretching.

Afterward, we agreed that we both had been sort of time bombs ticking, waiting for the midnight hour. If I hadn't wanted to be "seduced," I could have left while the lights were still on. But there was something desperate going on inside me, that wasn't just sexual desire or curiosity.

Our whispered conversation had gotten around to virginity, and my sort of in-between status, which I'd never told anyone about. But the booze loosened my tongue. When I was thirteen I was fooling around with a boy who had "borrowed" his sister's vibrator, and in the course of investigating how to use it, he was a little clumsy and popped me. It wasn't very painful, but it was the end of that relationship, right at the playing-doctor stage.

He didn't go to my school, so I didn't know whether any of the other boys knew about it, but I imagined they could all tell at a glance that I wasn't a virgin anymore. After about a year or so I realized that I still actually was.

I was unpopular and unattractive, or at least felt like it. Skipped a grade but then got it back after my parents took me out of school for a year to go overseas. They worked in London and Madrid and I went back and forth, learning about enough Spanish to order a Coke in a restaurant.

From not speaking Spanish it only took a few minutes for the conversation to get about to the difficulties of having sex in space, with lack of privacy being only one of several problems, with the conservation of momentum and angular momentum high on the list. Difficult to describe, so I asked him to demonstrate, with our clothes on, of course.

That stage didn't last too long. We explored another problem, that of getting at least partially undressed while both of you had to hold on to a handle or go spinning apart.

We did managed to get our bottoms mostly removed. He looked kind of large, if smaller than my friend's sister's vibrator, but he was slow and

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gentle. As soon as he got it all the way in, he ejaculated, but we stayed together and he recovered in a few minutes and did it again.

I'd been prepared for an ordeal, but in fact it was all pretty exciting and fun. I kept losing my grip and he'd swim after me, while I groped for one of the handles. We wound up floating in midair, though, holding each other's shoulders, rotating slowly, and then not slowly.

I didn't really have an orgasm until later, in the shower, but it was still overwhelming. Floating in space with Paul inside me, and me inside his arms. It took me a long time to fall asleep that night, and I woke up with the feeling still fresh. His face in the twilight, eyes closed, concentrating, and then losing control. And me not a virgin anymore, not even technically.

It was several days before we could find the privacy to talk about it. We both were in the galley for the last breakfast shift, and I killed some time cleaning up the microwave and prep area until the last people left.

He said it quickly, almost *sotto voce*: "Carmen, I'm sorry I took advantage of you."

"You didn't. I loved it."

"But you were drinking, and I really wasn't."

"Just to get up the courage." Not strictly true; I'm sure I would have had a couple no matter who was at the party. "Don't feel guilty." He was still sitting down; I leaned over and hugged him from behind. "Really, don't. You made me so happy."

I could tell he was trying not to squirm. "Made me happy too," he said in an unhappy voice.

I sat down across from him. "What? What is it? Age difference?".

"No. That's part of it, but no." He leaned back. "It's my being pilot, which is to say captain." He visibly struggled, trying to find words. "I want to show you how I feel, but I can't. I can't *court* you; I can't treat you differently from anybody else."

"Of course not. I wouldn't expect—"

"But I want to! That night meant as much to me, maybe more, and I want to treat you like a lover. I can't even wink at you, not really. Let alone hold your hand, or . . ."

Or do it again, I realized. Even if we manufactured an opportunity. "Do you really think it's a secret? The Manchesters pretty obviously left to give us some privacy."

"You haven't told anybody?"

"No." Not in so many words. But Elspeth and Kaimei gave me big grins that were pretty clear.

"That's important. The ship runs on rumor as much as hydrogen. People will whisper; they'll *know*, but as long as you and I keep it private, my . . . my authority isn't compromised."

His authority. And a devilish part of me wanted to tell everybody. *I'm a real woman—I'm fucking the captain.* "I can see that."

Somebody was coming down the ladder. He stood up.

It was my mother, coffee cup in hand.

"Oh . . . hello, Paul." Amazing how much she could communicate with two words.

"Morning, Laura. See you later, Carmen." He went up the ladder as soon as she let go.

She watched his retreating ass with a little smile. Then she got a spoonful of coffee and poured hot water on it. "I was younger than you," she said. "Seventeen, and no, it wasn't your father."

"You didn't meet until graduate school," I said inanely.

"He's eleven years older?"

"More like ten. He was born in February."

She put some sugar in the coffee, not normal for her. "Don't get too at-

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tached to him. He has a life on Mars, and he'll have to stay there."

"I might want to stay there, too." Even as I said the words, I couldn't believe they'd come out of my mouth.

"We all have the option, of course." She touched my shoulder. "He's a nice man. Don't forget there are a billion of them back on Earth."

She capped the coffee and swung up the ladder, back to her research station, without saying any motherly things like *don't let him hurt you* or *don't let your father know,* proving life is not a soap.

Of course Dad would know, along with everybody else. If the pilot had fucked any other innocent young thing, I suppose *I* would know by breakfast.

I didn't feel particularly young or innocent. If everyone knows, why not keep doing it? It wasn't as if I could get pregnant; with Delaze, I wouldn't start ovulating until after we'd landed on Mars, as he well knew. Even mighty space pilot sperm wouldn't live that long.

After we reached the halfway mark, all of us young ones met our volunteer "Mars mentors," people who weren't teachers or parents, but wanted to help us with our transition to their world.

My guy was "Oz," Dr. Oswald Penninger, a life scientist like Mother. He had a big smile and a salt-and-pepper beard.

Conversation was awkward, with an eight-minute delay between "How are you?" and "Fine," but we got used to it. It was kind of like really slow instant messaging. You ask a question and then do something else for a while, and he answers and then does something else for a while. We didn't normally use visual, unless there was something to show.

He was like everybody's favorite uncle, acknowledging the difference in our ages but then treating me like an equal who didn't know quite as much. I grew to like him better than most of the people on board, which I suppose was predictable. He was sixty-three, an African-American from Georgia, exobiologist and artist. They didn't have paper for drawing, of course, but he did beautifully intricate work onscreen that galleries in Atlanta and Oslo printed and sold.

Should an artist's pictures match his personality? Oz was a jolly plump man, given to sly wordplay and funny stories. But his art was dark and disturbing. He'd studied art in Norway for two years, and said his stuff was positively cheerful compared to the other people's in his studio. I'd have to see that to believe it.

He zapped me the software that he uses for drawing, but I've never had much talent in that direction. He said he'll show me some tricks when we meet in person. Meanwhile, I've downloaded a beginner's text on cartooning, and will try to learn enough to surprise him.

Funny to have a friend you've never touched or actually seen. I wonder whether we'll like each other in person.

15. Sexual disorder

About a week went by without Paul suggesting another tryst, if that's the right word. He seemed to be going out of his way to treat me like just another passenger, which was of course according to plan. But I was a little anxious because he was playing the part too well.

He wasn't avoiding me, but nobody on the ship was harder to get alone. I kept taking the last breakfast shift, and finally managed to corner him.

As I approached, he got a kind of resigned look, but reached out and took my hand. "I'm afraid I'm in trouble. With Mars."

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"Because of me?"

He shrugged. "You're not in trouble. But somebody heard, and is whizzed at me for 'seducing one of the Earth children.'"

"I'm not a child! I'm nineteen, going on thirty."

"As I pointed out. They still say it was immature and unprofessional of me. Maybe they're right."

"It's not fair. We didn't really do anything wrong."

"Somebody thinks otherwise. Somebody here, who told somebody there."

"Who? Someone who has it in for you, or me?"

"I'm pretty sure who it is on Mars, but I don't know about here. It didn't have to start out malicious; just a juicy scrap of gossip." He took a sip of coffee that was probably cold. "I hope your parents don't find out this way."

"Oh, they know. At least Mother does, and she's okay with it."

He nodded slowly. "That's good. But I guess we'd better put it on ice for awhile."

I tried to keep anger out of my voice. "I don't see why. What's done is done."

"The sexual part, yes. But now it would be insubordination as well. Which might be more serious. Would be."

"For your career."

"Not exactly. Nobody can *fire* me. But the colony's a small town, and I have to live there the rest of my life."

"If you . . ." I almost said something I would regret. "If you say so. But once we're on Mars?"

"Things will be different. People will get to know you and accept you as an adult."

"Eventually. Guess I'll be one of the kids from Earth for awhile."

"Not for long, I hope." He brightened. "Privacy isn't such an issue there, either, finding a time and place. My roommate wouldn't mind getting lost for a couple of hours, and you'll pick one you can trust."

Kaimei or Elspeth, for sure. "Unless they stick me with Card."

"They wouldn't be that cruel." He stood and hugged me and gave me a long kiss. "I'd better move along. You'll be okay?"

"Sure. I'm sorry. But I can wait." I didn't start crying until he was gone.

16. A new world

Someday, I thought, maybe before I'm dead, Mars will have its own space elevator, but until then people have to get down there the old-fashioned way, in space-shuttle mode. It's like the difference between taking an elevator from the top floor of a building and jumping off with an umbrella and a prayer. Fast and terrifying.

We'd lived with the lander as part of our home for weeks and then as a mysterious kind of threatening presence, airless and waiting. Most of us weren't eager to go into it.

Before we'd made our second orbit of Mars, Paul opened the inner door, prepared to crack the airlock, and said, "Let's go."

We'd been warned, so we were bundled up against the sudden temperature drop when the airlock opened, and were not surprised that our ears popped painfully. It warmed up for an hour, and then we had to take our little metal suitcases and float through the airlock to go strap into our assigned seats, and try not to shit while we dropped like a rock to our doom.

From my studies I knew that the lander loses velocity by essentially trading speed for heat—hitting the thin Martian atmosphere at a drastic angle so the ship heats up to cherry red. What the diagrams in the physical science book don't show is the tooth-rattling vibration, the bucking and gut-wrenching wobble. If I'm

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never that scared again in my life I'll be really happy.

All of the violence stopped abruptly when the lander decided to become a glider, I guess a few hundred miles from the landing strip. I wished we had windows like a regular airplane, but then realized that might be asking for a heart attack. It was scary enough just to squint at Paul's two-foot-wide screen as the ground rose up to meet us, too steep and fast to believe.

We landed on skis, grating and rumbling along the rocky ground. They'd moved all the big rocks out of our way, but we felt every one of the small ones. Paul had warned us to keep our tongues away from our teeth, which was a good thing. It could be awkward, starting out life on a new planet unable to speak because you've bitten off your tongue.

We hadn't put on the Mars suits for the flight down; they were too bulky to fit in the close-ranked seats—and I guess there wasn't any disaster scenario where we would still be alive and need them. So the first order of the day was to get dressed for our new planet.

We'd tested them several times, but Paul wanted to be super-cautious the first time they were actually exposed to the Martian near-vacuum. The airlock would only hold two people at once, so we went out one at a time, with Paul observing us, ready to toss us back inside if trouble developed.

We unpacked the suits from storage under the deck and sorted them out. One for each person and two blobby general purpose ones.

We were to leave in reverse alphabetical order, which was no fun, since it made our family dead last. The lander had never felt particularly claustrophobic before, but now it was like a tiny tin can, the sardines slowly exiting one by one.

At least we could see out, via the pilot's screen. He'd set the camera on the base, where all seventy-five people had gathered to watch us land, or crash. That led to some morbid speculation on Card's part. What if we'd crash-landed *into* them? I guess we'd be just as likely to crash into the base behind them. I'd rather be standing outside with a spacesuit on, too.

We'd seen pictures of the base a million times, not to mention endless diagrams and descriptions of how everything worked, but it was kind of exciting to see it in real time, to actually be here. The farm part looked bigger than I'd pictured it, I guess because the people standing around gave it scale. Of course the people lived underneath, because of radiation.

It was interesting to have actual gravity. I said it felt different and Mom agreed, with a scientific explanation. Residual centripetal blah blah blah. I'll just call it real gravity, as opposed to the manufactured kind. Organic gravity.

A lot of people undressed on the spot and got into their Mars suits. I didn't see any point in standing around for an hour in the thing. I'm also a little shy, in a selective way. Paul had touched me all over, but he'd never seen me without a top. I waited until he was on the other side of the airlock before I revealed my unvoluptuous figure and barely necessary bra. Which I'd have to take off anyhow, for the skinsuit part of the Mars suit.

That part was liked a lightweight body stocking. It fastened up the front with a gecko strip, and then you pushed a button on your wrist and something electrical happened and it clasped your body like a big rubber glove. It could be sexy looking, if your body was.

The outer part of the Mars suit was more like lightweight armor, kind of loose and clanky when you put it on, but it also did an electrical thing

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when you zipped up, and fit more closely. Then clumsy boots and gloves and a helmet, all airtight. The joints would sigh when you moved your arms or legs or bent at the waist.

Card's suit had a place for an extension at the waist, since he could grow as much as a foot taller while we were here. Mine didn't have any such refinement, though there was room to put on a little weight if I loved Mars cooking.

Since we did follow strict anti-alphabetical order, Card got the distinction of being the last one out, and I was next to last. I got in the airlock with Paul, and he checked my oxygen tanks and the seals on my helmet, gloves, and boots. Then he pumped most of the air out, watching the clock, and asked me to count even numbers backward from thirty. (I asked him whether he had an obsession with backward lists.) He smiled at me through the helmet and kept his hand on my shoulder as the rest of the air pumped out and the door silently swung open.

The sky was brighter than I'd expected, and the ground darker. "Welcome to Mars," Paul said on the suit radio, sounding clear but far away.

We walked down a metal ramp to the sandy, rock-strewn ground. I stepped onto another planet.

How many people had ever done that?

Everything was suddenly different. This was the most real thing I'd ever done.

They could talk until they were blue in the face about how special this was, brave new frontier, leaving the cradle of Earth, whatever, and it's finally just words. When I felt the crunch of Martian soil under my boot it was suddenly all very plain and wonderful. I remembered an old cube—a movie—of one of the first guys on the Moon, jumping around like a little kid, and I jumped myself, and again, way high.

"Careful!" came Paul's voice over the radio. "Get used to it first."

"Okay, okay." While I walked, feather light, toward the other airlock, I tried to figure out how many people had actually done it, set foot on another world. A little more than a hundred, in all of history. And me one of them, now.

There were six of them waiting at the airlock door; everyone else had gone inside. I looked around at the rusty desert and stifled the urge to run off and explore—I mean, for more than three months we hadn't been able to go more than a few dozen feet in any direction, and here was a whole new world. But there would be time. Soon!

Mother was blinking away tears, unable to touch her face behind the helmet, crying with happiness. The dream of her lifetime. I hugged her, which felt strange, both of us swaddled in insulation. Our helmets clicked together and for a moment I heard her muffled laugh.

While Paul went back to get Card, I just looked around. I'd spent hours there in virtual, of course, but that was fake. This was hard-edged and strange, even fearsome in a way. A desert with rocks. Yellow sky of air so thin it would kill you in a breath.

When Card got to the ground, he jumped higher than I had. Paul grabbed him by the arm and walked him over.

The airlock held four people. Paul and the two strangers gestured for us to go in when the door opened. It closed automatically behind us and a red light throbbed for about a minute. I could hear the muffled clicking of a pump. Then a green light and the inside door sighed open. "Home again," Paul said.

17. The land of Oz

We stepped into the greenhouse, a

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dense couple of acres of grain and vegetables and dwarf fruit trees. The air was humid and smelled of dirt and blossoms. A woman in shorts and a T-shirt motioned for us to take off our helmets.

She introduced herself as Emily. "I keep track of the airlock and suits," she said. "Follow me and we'll get you square."

Feeling overdressed, we clanked down a metal spiral stair to a room full of shelves and boxes, the walls unpainted rock. One block of metal shelves was obviously for our crew, names written on bright new tape under shelves that held folded Mars suits and the titanium suitcases.

"Just come on through to the mess hall after you're dressed," she said. "Place isn't big enough to get lost. Not yet." They planned to more than double the underground living area while we were here.

I helped Mother out of her suit and she helped me. I needed a shower and some clean clothes. My jumpsuit was wrinkled and damp with old sweat, fear sweat from the landing. I didn't smell like a petunia myself. But we were all in the same boat.

Paul and the two other men in Mars suits were rattling down the stairs as we headed for the mess hall. The top half of the corridor was smooth plastic that radiated uniform dim light, like the tubes that had linked the Space Elevator to the Hilton and the *John Carter*. The bottom half was numbered storage drawers.

I knew what to expect of the mess hall and the other rooms; the colony was a series of inflated half-cylinders inside a large irregular tunnel, a natural pipe through an ancient lava flow. Someday the whole thing would be closed off and filled with air like the part we'd just left, but for the time being everyone lived and worked in the reinforced balloons.

We walked through a medical facility, bigger than anything we'd seen since the Hilton. No people, just a kind of medicated smell. Forty or fifty feet wide, it all seemed pretty huge after living in a spaceship. I don't suppose it would be that imposing if you went there directly from a town or a city on Earth.

The murmur of voices was pretty loud before we got to the mess hall. It sounded like a cocktail party, though the only thing to drink was water, and you don't dare spill a drop.

The mess hall was big enough for about two dozen people to eat at once, and now there were a hundred or so, sitting on the tables as well as the chairs, milling around saying hello. We twenty-three were the first new faces they'd seen in a year and a half—about one Martian year, one "are," pronounced air-ee. I'd better start thinking that way.

The room had two large false windows, like the ones on the ship, looking out onto the desert. I assumed they were real-time. Nothing was moving, but then all the life on the planet was presumably right here.

You could see our lander sitting at the end of a mile-long plowed groove. I wondered whether Paul had cut it too close, stopping a couple of hundred feet away. He'd said the landing was mostly automatic, but I didn't see him let go of the joystick.

I saw Oz immediately, and threaded my way over to him. We shook hands and then hugged. He was a little bit shorter than me, which was a surprise. He held me by both shoulders and looked at me with a bright smile, and then looked around the room. "It's pretty strange, isn't it? All these people."

Seventy-five new faces after seeing the same three dozen for months. "They look like a bunch of Martians."

He laughed. "Was the landing rough?"

"Pretty awful. But Paul seemed in

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control."

"He was my pilot, too. Good old 'Crash' Collins."

"'Crash'?"

"Ask him about it someday."

An Asian woman a little taller than Oz came over, and he put his arm around her waist. "Josie, this is Carmen."

We shook hands. "I've seen your picture," she said. Josie Tang, Oz's lover. "Welcome to our humble planet."

I tapped my foot on the metal plate. "Nice to have real gravity."

"The same no matter where you go," Oz said. "I'll give you a tour after the formalities."

When Paul and the other two came into the room, an older woman started tapping on a glass with a spoon. Like many of them, men and women, she was wearing a belted robe made of some filmy material. She was pale and bony.

"Welcome to Mars. Of course I've spoken with most of you. I'm Dargo Solingen, current general administrator.

"The first couple of sols"—Martian days—"you are here, just settle in and get used to your new home. Explore and ask questions. We've assigned temporary living and working spaces to everyone, a compromise between the wish list you sent a couple of weeks ago and . . . reality." She shrugged. "It will be a little tight until the new modules are in place. We will start on that as soon as the ship is unloaded."

She almost smiled, though it looked like she didn't have much practice with it. "It is strange to see children. This will be an interesting social experiment."

"One you don't quite approve of?" Dr. Jefferson asked.

"You probably know that I don't. But I was not consulted."

"Dr. Solingen," a woman behind her said in a tone of warning.

"I guess none of you were," he said. "It was an Earth decision, the Corporation."

"That's right," Solingen said. "This is an outpost, not a colony. They don't have families on Moonbase or even Antarctica."

Oz cleared his throat. "We were polled. Most of us were very much in favor." And most of them did call it "the colony," rather than Mars Base One.

The woman who had cautioned Solingen continued. "A hundred percent of the permanent party. Those of us who are not returning to Earth." She was either pregnant or the only fat person in the room. Looking more carefully, I saw one other woman who appeared to be pregnant.

You'd think that would have been on the news. Maybe it was, and I missed it, not likely. Mother and I exchanged significant glances. Something was going on.

(It turned out to be nothing more mysterious than a desire for privacy on the women's part, and everybody's desire to keep Earth out of their hair. When the first child was born, the Earth press would be all over them. Until then, there was no need for anyone to know the blessed event was nigh. So they asked that we not mention the pregnancies when writing or talking to home.)

Solingen went on to talk about work and living schedules. For those of us in school, study schedules would continue as on the *John Carter*, and we'd be assigned light duties "appropriate to our abilities." Probably fetch-and-carry or galley slave, as we called kitchen work on ship.

Then she introduced each new arrival, stating where they were from, what their specialties were, and lists of honors and awards, all from memory. It was an impressive perfor-

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mance. She even knew about us youngsters—Mike Baker's national (Canadian) spelling bee, Yuri's solo with the St. Petersburg orchestra, and my swimming medal, an extremely useful skill on this planet.

The way she looked at me left no doubt who it was who forbade Paul from being with me. I would try to stay out of her way.

People got together with friends or coworkers—almost everybody had been working along with one of the Martian teams en route—and moved toward the workstations and labs to talk. Oz and Josie took me and Card for a guided tour.

We'd already walked through the "hospital," an aid station about three meters wide by ten long. It was connected to the changing room by an automated airlock; if there was an accident with the main airlock, it would seal off the whole colony.

That was the standard size for most of the buildings, three by ten meters, but most of them were divided into smaller sections. The mess hall where we all met was about two thirds that size, two-hundred square meters for a hundred not-too-crowded people, the rest of the space a very compressed kitchen and pantry.

About half of the overall floor space was "cabins," more like walk-in closets, where people slept. Most of them were two meters long by a meter wide, three meters high, with upper and lower bunks for two people who better be compatible. The bunks folded up to the wall, and desks for working or reading folded down. Four of the cabins were a half meter longer, for seven-footers.

The walls were colorful, in sometimes odd combinations. Each unit, twelve to thirty-two people, voted on a weekly color scheme. The walls glowed a comforting warm beige or cool blue most places, but there were bright yellows and moody purples and a Halloween orange.

We walked down the main corridor, about a meter wide, past six rows of cabins. The last bunch of sixteen had temporary partitions and improvised bunks, where most of us newcomer Earthlings will sleep. In normal times, that would be the recreation area, so people had real motivation to set up the new living areas we'd brought.

Then there were three large work areas, which besides labs and computer stations contained separate rooms for administration, power regulation, and environmental control—water, air, and heat. Finally, there was an airlock leading to the biosciences laboratory, where there were strict controls. We tried to be careful not to contaminate the Martian environment, and conversely, if there were dormant alien microorganisms in the rock and soil specimens, we didn't want to let even one of them into our air and water. The consensus was that it was unlikely Martian microbes could affect us, but who wants to put it to the test? The whole area was kept at a slightly lower air pressure than the rest of the colony, discouraging leaks.

Here I was on a brand new world, making history, and my phone beeped to remind me that I had a history paper due tomorrow. I thumbed that it would be a day late, 10 percent grade reduction.

Oz invited Card and me back to the cabin he shared with Josie. The four of us could sit comfortably on the lower bunk. He showed me how the desk worked, folding down with retractable arms, revealing a small high-definition screen. The work surface was flat but had a virtual keyboard. The arms were a clever parallelogram construction that let you position the desk at various heights.

The walls were covered with pictures, only two his own work. From

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art history class I recognized Rembrandt, Pollack, and Wyeth paintings; the others were by Scandinavian artists I'd never heard of.

A public address system called all "new colonists" to dinner. It was fantastic, after months of ship rations. Salad with fresh greens and tomatoes, hot cornbread, fried tilapia.

After the meal, we were invited to come up and look at the farm. Those tilapia weren't the happiest-looking fish I'd ever seen, crowded into a small tank of murky water with agricultural waste (their food) floating on top.

Most of the crops had supplemental lights over their beds, Martian sunlight being pretty thin. It was easy to recognize stands of corn and apple trees, tomato plants, and beds of lettuce and cabbage. I didn't know what rice looked like, but it was probably different on Earth anyhow; not enough water here for paddies. Kaimei laughed when she saw it.

We went back down to get our assigned sleeping areas straight and get on the shower roster. There were two showers, and you could sign up for a twenty-minute interval for the female one. (The men only had fifteen minutes; there were more of them.) There was a complicated list of instructions in the small dressing room.

We were allowed 160 minutes per month, two showers a week. The twenty shower minutes you had included ten for undressing and dressing. The ten minutes you were actually in the shower included only five minutes of actual running water: get wet, then soap and shampoo, and then try to rinse off.

All of us newbies were penciled in for showers if we wanted them—*if!* I had one scheduled for 1720, and waited outside the door for ten minutes. Mrs. Washington came out, radiantly clean, and I slipped in to undress and wait for Kaimei to finish, behind the shower curtain. The dressing room was the same size as the shower, about a meter square, and unsurprisingly smelled like a girls' locker room on Earth.

I chatted with Kaimei through the curtain when her water stopped and she switched to the dryer. No towels, just a hot-air machine. She came out, looking all new and shiny, and I moved my sweaty corpus in to be sluiced.

It was an odd sensation. The water that sprayed from the handheld nozzle was warm enough, but the rest of your body gets really cold, the water on your skin evaporating fast in the thin air.

The amber liquid that served as both soap and shampoo was watery and weak, probably formulated more for its recycling efficiency than its cleaning power. But I did get pretty clean, much cleaner than I'd ever felt on the ship. I used the last thirty seconds of rinse time letting the warm water roll down my tired back.

There was a fixed dryer about four feet off the ground, somewhat amiable, to get your back and butt dry, and a handheld thing like a powerful hair dryer for the rest. The heat was welcome, and I felt pretty wonderful when I pulled the curtain.

Dargo Solingen stood there naked, bony and parchment pale. She marched by me without a word. I managed "Hello?"

I dressed quickly and looked at the roster. There had been someone else's name after mine, someone unfamiliar, but now it was Dargo Solingen. I supposed she could butt in line any time she wanted, pulling rank. But it was an odd coincidence. Did she want to see the sexy body that seduced her pilot? As if you would have to be a great beauty to appeal to a guy who's been celibate for three months. I think "nominally female" would fill the bill.

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18. Marswalk

I shared a small temporary space with Elspeth and Kaimei—an air mattress on the floor and a bunk bed. We agreed to rotate, so everyone would have a bed two thirds of the time.

No romantic trysts for a while. I could ask the girls to look the other way, but Paul might feel inhibited.

Hanging sheets for walls and only one desk, with a small screen and a clunky keyboard and an old VR helmet with a big dent on the side. The timing for that worked out okay, since Elspeth had classes seven hours before Eastern Time, and Kaimei three hours later. We drew up a chart and taped it over the desk. The only conflict was my physical science class versus Kaimei's History of Tao and Buddhism. Mine was mostly equations on the board, so I used the screen and let her have the helmet.

Our lives were pretty regimented the first couple of weeks, because we had to coordinate classes with the work roster here, and leave a little time for eating and sleeping.

Everybody was impatient to get the first new module set up, but it wasn't just a matter of unloading and inflating it. First there was a light exoskeleton of spindly metal rods that became rigid when they were all pulled together. Then floorboards to bear the weight of the things and people inside. Then the connection to the existing base, through an improvised airlock until they were sure the module wouldn't leak.

I enjoyed working on that, at first outdoors, unloading the ship and sorting and preassembling some parts; then later, down in the cave, attaching the new to the old. I got used to working in the Mars suit and using the "dog," a wheeled machine about the size of a large dog. It carried backup oxygen and power.

About half the time, though, my work roster put me inside, helping the younger ones do their lessons and avoid boredom. "Mentoring," they called it, to make it sound more important than babysitting.

I hardly ever saw Paul. It's as if whoever was in charge of the work details—guess who—took a special effort to keep us apart. One day, though, while I was just getting off work detail, he found me and asked whether I'd like to go exploring with him. What, skip math? I got fresh oxygen and helped him check out one of the dogs, and we went for a walk.

The surface of Mars might look pretty boring to an outsider, but it's not at all. It must be the same if you live in a desert on Earth: you pretty much have the space around your home memorized, every little mound and rock—and when you venture out it's, "Wow! A different rock!"

He took me off to the left of Telegraph Hill, walking at a pretty good pace. The base was below the horizon in less than ten minutes. We were still in radio contact as long as we could see the antenna on top of the hill, and if we wanted to go farther, the dog had a collapsible booster antenna that went up ten meters, which we could leave behind as a relay.

We didn't need it for that, but Paul clicked it up into place when we came to the edge of a somewhat deep crater he wanted to climb into.

"Be really careful," he said. "We have to leave the dog behind. If we both were to fall and be injured, we'd be in deep shit."

I followed him, watching carefully as we picked our way to the top. Once there, he turned around and pointed.

It's hard to say how strange the sight was. We weren't that high up, but you could see the curvature of the horizon. The dog behind us looked tiny but unnaturally clear, in

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the near vacuum. To the right of Telegraph Hill, the pad where the *John Carter* had been raised to stand on its tail, waiting for the synthesizer to slowly make fuel from the Martian air.

Paul was carrying a white bag, now a little rust-streaked from the dust. He pulled out a photomap of the crater, unfolded it, and showed it to me. There were twenty X's, with numbers from one to twenty, starting on the top of the crater rim, where we must have been standing, then down the incline, and across the crater floor to its central peak.

"Dust collecting," he said. "How's your oxygen?"

I chinned the readout button. "Three hours forty minutes."

"That should be plenty. Now you don't have to go down if you—"

"I do! Let's go!"

"Okay. Follow me." I didn't tell him that my impatience wasn't all excitement, but partly anxiety at having to talk and pee at the same time. Peeing standing up, into a diaper, trying desperately not to fart. "Funny as a fart in a spacesuit" probably goes back to the beginning of space flight, but there's nothing real funny about it in reality. I'd taken two anti-gas tablets before I came out, and they seemed to still be working.

Keeping your footing was a little harder, going downhill. And it had been some years since I'd walked with a wet diaper. I was out of practice.

Paul had the map folded over so it only showed the path down the crater wall; every thirty or forty steps he would fish through the bag and take out a pre-labeled plastic vial and scrape a sample of dirt into it.

On the floor of the crater I felt a little shiver of fear at our isolation. Looking back the way we'd come, though, I could see the tip of the dog's antenna.

The dust was deeper than I'd seen anyplace else, I guess because the crater walls kept out the wind. Paul took two samples as we walked toward the central peak.

"You better stay down here, Carmen. I won't be long." The peak was steep, and he scrambled up it like a monkey. I wanted to yell, "Be careful," but kept my mouth shut.

Looking up at him, the sun sinking under the crater's rim, I could see Earth gleaming blue in the ochre sky. How long had it been since I thought of Earth, other than "the place where school is"? I guess I hadn't been here long enough to feel homesickness. Nostalgia for Earth—crowded place with lots of gravity and heat.

It might be the first time I seriously thought about staying. In five years I'd be twenty-four and Paul would still be in his early thirties. I didn't feel as romantic about him as I had on the ship. But I liked him and he was funny. That would put us way ahead of a lot of marriages I'd observed.

But then how did I really feel about him? Up there being heroic and competent and, admit it, sexy.

Turn down the heat, girl. He's only twelve years younger than your father, Probably sterile from radiation, too. I didn't think I wanted children, but it would be nice to have the option.

Meanwhile, he would be fun to practice with.

He collected his samples and tossed the bag down. It drifted slowly, rotating, and landed about ten feet away. I was enough of a Martian to be surprised to hear a faint click when it landed, the soles of my boots picking the noise up, conducted through the rock of the crater floor.

He worked his way down slowly, which was a relief. I was holding the sample bag; he took it and made the hand signal for "turn off your communicator." I did and he stepped over close enough to touch helmets. His

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face close enough to kiss. He spoke, and his voice was a faraway whisper. "Can you come sleep with me tonight?"

"Yes! Oh, yes."

"My roommate's putting in an extra half shift, from 1800 to 2300. Are you free during that time?"

"Class till 1900, but then, sure."

He gave me an awkward squeeze. Hard to be intimate in a Mars suit, but I could feel his gloves on my shoulders, the welcome pressure of his chest.

He turned his comm back on and gave me a mischievous wink. I followed him back the way we had come.

At the top of the crater wall, he stopped and looked back. "Can't see it from here," he said. "I'll show you."

"What?"

"My greatest triumph," he said, and started down. "You'll be impressed."

He didn't offer any further explanation on the ground. He picked up the dog's handle and proceeded to walk around to the other side of the crater.

It was a dumbo, an unpiloted supply vehicle. Its rear end was tilted up, the nose down in a small crater.

"I brought her in like that. I was not the most popular man on Mars." As we approached it, I could see the ragged hole someone had cut in the side with a torch or a laser. "Landed it right on the cargo bay door, too."

So that was how he'd become "Crash" Collins. "Wow. I'm glad you weren't hurt."

He laughed. "It was remote control; I landed it from a console inside the base. Harder than being aboard, actually." We turned around and headed back to the base.

"It was a judgment call. There was a lot of variable wind, and it was yawing back and forth." He made a hand motion like a fish swimming. "I was sort of trying not to hit the base or Telegraph Hill. But I overdid it."

"People could understand that."

"Understanding isn't forgiving. Everybody had to stop their science and become pack animals." I could see the expression on Solingen's face, having to do labor, and smiled.

She really did have something against me. I had to do twice as much babysitting as Elspeth or Kaimei—and when I suggested that the boys ought to do it, too, she said the "personnel allocation" was *her* job, thank you. And when my person got allocated to an outside job, it would be something boring and repetitive, like taking inventory of supplies. (That was especially useful, in case there were actual Martians sneaking in at night to steal nuts and bolts.)

When we got back, I went straight to the john and recycled the diaper and used a couple of towelettes from my allotment. No shower for eighteen hours, but I was reasonably fresh, and Paul wouldn't be that critical.

At the console there was a blinking note from the Dragon herself, noting that I had missed math class, saying she wanted a copy of my homework. Did she monitor anybody else's VR attendance?

I'd had the class recorded, of course, the super-exciting chain rule for differentiation. I fell asleep twice, hard to do in VR, and had to start over. Then I had a problem set with fifty chains to differentiate. Wrap me in chains and throw me in the differential dungeon, but I had to get a nap before going over to Paul's. I set a beeper for 1530, ninety minutes, then got the air mattress partly inflated and flopped onto it without undressing.

At 1800 I tried to concentrate on a physical science lecture about the conservation of angular momentum. Sexy dancers and skaters spinning around. The lecturer reminded me of

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Paul. Probably any male would have.

Went to the john and freshened up here and there. Then walked up to 4A—no way to be discreet about it—and tapped quietly on the door. Paul opened it and sort of pulled me in.

We hugged and kissed and undressed each other in a kind of two-person riot. He was extremely erect; I played with it for a minute, but he said that might prove counterproductive, and carried me to the bed and caressed me all over, and with his hands and tongue brought me to orgasm twice, my jaws clenched, trying not to make too much noise.

Then he showed me a picture of a frieze in India and I copied it, putting my arms around his neck and clasping his hips with my legs while he entered me. Probably a lot easier on Mars than in India. It was a pleasant sensation but odd, since he completely filled me, his penis bumping the top of my vagina with every thrust.

Maybe in the future there will be advertisements: *Come to Mars and fuck like an Indian goddess.* Maybe not.

I didn't have a third orgasm in me, but his was plenty for both of us. Then we lay in his narrow bunk, spoon fashion, dozing, until his erection came back and we did it again, in that position. Nicely intimate but not too stimulating, which he took care of afterwards with his fingers.

An hour or so of dreamless sleep and he woke me with a hand on my shoulder. He was fully dressed. "Jerry wouldn't mind walking in on you like this," he said, "but you might be startled."

I dressed quickly and kissed him good-night. There was nobody in his corridor, but I did pass a couple on the main way, including Jerry, who gave me an arched eyebrow and a little wave.

I slipped into our temporary room and undressed quietly without turning on the lights.

"So how was our pilot?" Kaimei murmured in the dark. When I didn't say anything, she continued. "A simple deduction, Sherlock. You don't exactly smell like you've been riding a bicycle."

"I'm sorry . . ."

"I didn't say I didn't like it. Sweet dreams."

In fact, my dream was odd and disturbing. I was trying to find a party, but every door opened onto an empty room. The last door opened onto the sea.

Not delivering my homework like a good little girl got me into a special corner of Dargo Hell. I had to turn over my notes and homework in maths every day to Ana Sitral, who obviously didn't have time for checking it. She must have done something to piss off the Dragon herself.

Then I had to take on over half of the mentoring hours that Kaimei and Elspeth had been covering, and was not allowed any outside time. The extra babysitting time came out of my ag hours, working on the farm upstairs, which most of us considered a treat, as Dargo well knew.

I had been selfish, she said, tiring myself out on a silly lark, using up resources that might be needed for real work. So I had the temerity to suggest that part of my real work was getting to know Mars, and she really blew up about that. It was not up to me to make up my own training schedule.

Okay, part of it was that she didn't like young people. But part was also that she didn't like *me,* the sex kitten who'd distracted her pilot. She didn't bother to hide that from anybody. I complained to Mother and she didn't disagree, but said I had to learn to work with people like that. Especially here, where there wasn't much choice.

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I didn't bother complaining to Dad. He would make a Growth Experience out of it. I should try to see the world her way. Sorry, Dad. If I saw the world her way and cast my weary eyes upon Carmen Dula, wouldn't that be self-loathing? That would not be a positive growth experience.

19. Fish out of water

After a month, I was able to put a Mars suit on again, but I didn't go up to the surface. There was plenty of work down below, inside the lava tube that protected the base from cosmic and solar radiation.

There's plenty of water on Mars, but most of it is in the wrong place. If it was ice on or near the surface, it had to be at the north or south pole. We couldn't put bases there, because they were in total darkness a lot of the time, and we needed solar power.

But there was a huge lake hidden a few hundred meters below the base. It was the easiest large one to get to on all of Mars, we learned from some kind of satellite radar, which was why the base was put here. One of the things we'd brought on the *John Carter* was a drilling system designed to tap it. (The drills that came with the first ship and the third broke, though, the famous Mars Luck.)

I worked with the team that set the drill up, nothing more challenging than fetch-and-carry, but a lot better than trying to mentor kids when you wanted to slap them instead.

For a while we could hear the drill through our boots, a faint sandpapery sound that was conducted through the rock. Then it was quiet, and most of us forgot about it. A few weeks later, though, it broke through. It was Sagan 12th, which from then on would be Water Day.

We put on Mars suits and then walked down between the wall of the lava tube and the base's exterior wall. It was kind of creepy, just suit lights, less than a meter between the cold rock and the inflated plastic you weren't supposed to touch.

Then there was light ahead, and we came out into swirling madness—it was a blizzard! The drill had struck ice and liquefied it and sent it up under pressure, dozens of liters a minute. When it hit the cold vacuum it exploded into snow.

It was ankle-deep in places, but of course it wouldn't last; the vacuum would evaporate it eventually. But people were already working with lengths of pipe, getting ready to fill the waiting tanks up in the hydroponics farm. One of them had already been dubbed the swimming pool. That's how the trouble started.

I got on the work detail that hooked the water supply up to the new pump. That was to go in two stages: emergency and "maintenance."

The emergency stage worked on the reasonable assumption that the pump wasn't going to last very long. So we wanted to save every drop of water we could, while it still did work.

This was the "water boy" stage. We had collapsible insulated water containers that held fifty liters each. That's about 110 pounds on Earth, about my own weight, awkward but not too heavy to handle on Mars.

All ten of the older kids alternated a couple of hours on, a couple off, doing water boy. We had wheelbarrows, three of them, so it wasn't too tiring. You fill the thing with water, which takes eight minutes, then turn off the valve and get away fast, so not too much pressure builds up before the next person takes over. Then trundle the wheelbarrow up a ramp and around to the airlock, leave it there, and carry or drag the water bag inside and across the farm to the storage tanks. Dump in the water—a

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slurry of ice by then—and go back to the pump with your wheelbarrow and empty bag.

The work was boring as dust, and would drive you insane if you didn't have music. I started out being virtuous, listening to classical pieces that went along with my textbook on the history of music. But as the days droned by, I listened to more and more city and even sag.

You didn't have to be a math genius to see that it was going to take three weeks at this rate to fill the first tank, which was two meters tall and eight meters wide, bigger than some backyard pools in Florida.

The water didn't stay icy; they warmed it up to above room temperature. We all must have fantasized about diving in there and paddling around. Elspeth and Kaimei and I even planned for it.

There was no sense in asking permission from the Dragon. What we were going to do was coordinate our showers so we'd all be squeaky clean—so nobody could say we were contaminating the water supply—and come in the same time, off shift, and see whether we could get away with a little skinny-dip. Or see how long we could do it before somebody stopped us.

At two weeks, the engineers sort of forced our hand. They'd been working on a direct link from the pump to this tank and the other two.

Jordan Westling, Barry's inventor dad, seemed to be in charge of that team. We always got along pretty well. He was old but always had a twinkle in his eye.

He and I were alone by the tank while he fiddled with some tubing and gauges. I lifted the water bag with a groan and poured it in.

"This ought to be the last day you have to do that," he said. "We should be on line in a few hours."

"Wow." I stepped up on a box and looked at the water level. It was more than half full, with a little layer of red sediment at the bottom. "Dr. Westling . . . what would happen if somebody went swimming in this?"

He didn't look up from the gauge. "I suppose if somebody washed up first and didn't pee in the pool, nobody would have to know. It's not exactly distilled water. Not that I would endorse such an activity."

When I went back to the water point I touched helmets with Kaimei—always assuming the suit radio was monitored—and we agreed we'd do it at 0215, just after the end of the next shift. She'd pass the word on to Elspeth, who came on at midnight. That would give her time to have a quick shower and smuggle a towel up to the tank.

I got off at ten and VR'ed a class on Spinoza, better than any sleeping pill. I barely stayed awake long enough to set the alarm for 1:30.

Two and a half hours' sleep was plenty. I awoke with eager anticipation and, alone in the room, put on a robe and slippers and quietly made my way to the shower. The roster was almost empty at this hour.

Kaimei had already bathed, and was sitting outside the shower with a reader. I took my shower and, while I was drying, Elspeth came in from work, wearing skinsuit and socks.

After she showered, the three of us tiptoed past the work/study area—a couple of people were working there, but a hanging partition kept them from being distracted by passersby.

The mess hall was deserted. We went up through the changing room and the airlock foyer and slipped into the farm.

There were only dim maintenance lights at this hour. We padded our way to the swimming pool tank—and heard whispered voices!

Oscar Jefferson, Barry Westling,

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and my idiot brother had beat us to it!

"Hey girls," Oscar said. "Look—we're out of a job." A faucet in the side was gurgling out a narrow stream.

"My father said we could quit," Barry said, "so we thought we'd take a swim to celebrate."

"You didn't tell him," I said.

"Do we look like idiots?" No, they looked like naked boys. "Come on in. The water's not too cold."

I looked at the other two girls and they shrugged okay. Spaceships and Mars bases don't give you a lot of room for modesty.

I sort of liked the way Barry looked at me anyhow, when I stepped out of my robe and slippers. When Kaimei undressed his look might have been a little more intense.

I stepped up on the box and had one leg over the edge of the tank, not the most modest posture, when the lights snapped on full.

"Caught you!" Dargo Solingen marched down the aisle between the tomatoes and the squash. "I *knew* you'd do this." She looked at me, one foot on the box and the other dangling in space. "And I know exactly who the ringleader is."

She stood with her hands on her hips, studying. Elspeth was only half undressed, but the rest of us were obviously ready for some teenaged sex orgy. "Get out now. Get dressed and come to my office at 0800. We will have a disciplinary hearing." She stomped back to the door and snapped off the bright lights on her way out.

"I'll tell her it wasn't you," Card said. "We just kind of all decided when Barry's dad said the thing was working,"

"She won't believe you," I said, stepping down. "She's been after my ass all along."

"Who wouldn't be?" Barry said. He was a born romantic.

* * *

All of our parents were crowded into the Dragon's office at 0800. That was not good. My parents both were working the shift from 2100 to 0400, and needed their sleep. The parents were on one side of the room, and we were on the other, with a large video screen in the middle.

Without any preamble, Dargo Solingen made the charge: "Last night your children went for a swim in the new Water Tank One. Tests on the water reveal traces of coliform bacteria, so it cannot be used for human consumption without boiling or some other form of sterilization."

"It was only going to be used for hydroponics," Dr. Westling said.

"You can't say that for certain. At any rate, it was an act of extreme irresponsibility, and one that you encouraged." She pointed a hand control at the video screen and clicked. I saw myself talking to him.

"What would happen if somebody went swimming in this?" He answered that nobody would have to know—not that he would endorse such a thing. He was restraining a smile.

"You're secretly recording me?" he said incredulously.

"Not you. Her."

"She didn't do it!" Card blurted out. "It was my idea."

"You will speak when spoken to," she said with ice in her voice. "Your loyalty to your sister is touching, but misplaced." She clicked again, and there was a picture of me and Kaimei at the water point, touching helmets.

"Tonight has to be skinny-dipping night. Dr. Westling says they'll be online in a few hours. Let's make it 0215, right after Elspeth gets off." You could hear Kaimei's faint agreement.

"You had my daughter's suit bugged?" my father said.

"Not really. I just disabled the OFF

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switch on her suit communicator."

"That is so . . . so illegal. On Earth they'd throw you out of court and then—"

"This isn't Earth. And on Mars, there is nothing more important than water. As you would appreciate more if you had lived here longer." Oh, sure, like living in a spaceship doesn't count. I think you could last longer without water than without air.

"Besides, it was improper for the boys and girls to be together naked. Even if they hadn't planned any sexual misbehavior—"

"Oh, please," I said. "Excuse me for speaking out of turn, Dr. Solingen, but there was nothing like that. We didn't even know the boys would be there."

"Really. The timing was remarkable, then. And you weren't acting surprised about them when I turned on the lights. Nor modest." Card was squirming and put up his hand, but the Dragon ignored it. She turned to the parents. "I want to discuss with you what punishment might be appropriate."

"Twenty laps a day in the pool," Dr. Westling said, almost snarling. He didn't like her anyhow, I'd noticed, and spying on him apparently had been the straw that broke the camel's back. "They're just kids, for Chris'sake."

"You're going to say they didn't mean any harm. They have to learn that Mars doesn't recognize intent as an excuse.

"An appropriate punishment, I think, would start with not allowing them to bathe for a month. I would also reduce the amount of water they be allowed to drink, but that is difficult to control. And I wouldn't want to endanger their health." God, she was so All Heart.

"For that month, I would also deny them recreational use of the cube and VR, and no exploring on the surface. Double that for the instigator, Ms. Dula"—and she turned back to face us—"and her brother as well, if he insists on sharing the responsibility."

"I *do!*" he snapped.

"Very well. Two months for both of you."

"It seems harsh," Kaimei's father said. "Kaimei told me that the girls did take the precaution of showering before entering the water."

"Intent means nothing. The bacteria are there."

"Harmless to plants," Dr. Westling repeated. "Probably to people."

She looked at him for a long second. "Your dissent is noted. Are there any other objections to this punishment?"

"Not the punishment," my mother said, "but Dr. Dula and I both object to the means of acquiring evidence."

"I am perfectly willing to stand on review for that." The old-timers would probably go along with her. The new ones might still be infected by the Bill of Rights, or the laws of Russia and France.

There were no other objections, so she reminded the parents that they would be responsible for monitoring our VR and cube use, but even more, she would rely on our sense of honor.

What were we supposed to be "honoring," though? The now old-fashioned sanctity of water? Her right to spy on us? In fact, her unlimited authority?

I would find a way to get back at her.

20. Nightwalk

After one day of steaming over it, I'd had enough. I don't know when I made the decision, or whether it even *was* a decision, rather than a kind of sleepwalking. It was sometime before three in the morning. I was still feeling so angry and embarrassed I couldn't get to sleep.

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So I got up and started down the corridor to the mess hall, nibble on something. But I walked on past.

It looked like no one else was up. Just dim safety lights. I wound up in the dressing room and realized what I was doing.

The airlock had a WARNING OVERRIDE button that you could press so the buzzer wouldn't go on and on if you had to keep the inner door open. Card had shown me how you could keep the button stuck down with the point of a pencil or a pen.

With the airlock buzzer disabled, a person could actually go outside alone, undetected. Card had done it with Barry for a few minutes early one morning, just to prove it could be done. So I could just be by myself for an hour or two, then sneak back in.

And did I ever want to be by myself.

I went through the dress-up procedure as quietly as possible. Then before I took a step toward the airlock, I visualized myself doing a safety check on another person and did it methodically on myself. It would be so pathetic to die out there, breaking the rules.

I went up the stairs silently as a thief. Well, I *was* a thief. What could they do, deport me?

For safety's sake, I decided to take a dog, even though it would slow me down a bit. I actually hesitated, and tested carrying two extra oxygen bottles by themselves, but that was awkward. *Better safe than sorry*, I said to myself in Mother's voice, and ground my teeth while saying it. But going out without a dog and dying would be pathetic. Arch-criminals are evil, not pathetic. I clicked the OVERRIDE button down and jammed it with the point of a penstick.

The evacuating pump sounded loud, though I knew you could hardly hear it in the changing room. It rattled off into silence, then the red light glowed green and the door swung open into darkness.

I stepped out, pulling the dog, and the door slid shut behind it.

I decided not to turn on the suit light, and stood there for several minutes while my eyes adjusted. Walking at night just by starlight—you couldn't do that any other place I've lived. It wouldn't be dangerous if I was careful. Besides, if I turned on a light, someone could see me from the mess hall window.

The nearby rocks gave me my bearings, and I started out toward Telegraph Hill. On the other side of the hill I'd be invisible from the base, and vice versa—alone for the first time in almost a year. Earth year.

Seeing the familiar rock field in this ghostly half-light brought back some of the mystery and excitement of the first couple of days. The landing and my first excursion with Paul.

If he knew I was doing this—well, he might approve, secretly. He wasn't much of a rule guy, except for safety.

Thinking that, my foot turned on a small rock and I staggered, getting my balance back. Keep your eyes on the ground while you're walking. It would be, what is the word I'm looking for, *pathetic* to trip and break your helmet out here.

It took me less than a half hour to get to the base of Telegraph Hill. It wasn't all that steep, but the dog's traction wasn't really up to it. A truly adventurous person would leave the dog behind and climb to the top with her suit air alone, and although I do like adventure, I'm also afflicted with *pathetico*-phobia. The dog and I could go around the mountain rather than over it. I decided to walk in a straight line for one hour, see how far I could get, and walk back, following the dog's track in the dust.

That was my big mistake. One of them, anyhow. If I'd just gone to the

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top, taken a picture, and headed straight back, I might have gotten away with the whole thing.

I wasn't totally stupid. I didn't go into the hill's "radio shadow," and I cranked the dog's radio antenna up all the way, since I was headed for the horizon, and knew that any small depression in the ground could hide me from the colony's radio transceiver.

The wind picked up a little. I couldn't feel or hear it, of course, but the sky showed it. Jupiter was just rising, and its bright pale yellow light had a halo and was slightly dimmed by the dust in the air. I remembered Dad pointing out Jupiter and then Mars the morning we left Florida, and had a delicious shiver at the thought that I was standing on that little point of light now.

The area immediately around the colony was as well explored as any place on Mars, but I knew from rockhounding with Paul that you could find new stuff just a couple hundred meters from the airlock door. I went four or five kilometers, and found something really new.

I had been going for fifty-seven minutes, about to turn back, and was looking for a soft rock that I could mark with an X or something—maybe scratch "SURRENDER PUNY EARTHLINGS" on it, though I suspected people would figure out who had done it.

There was no noise. Just a suddenly weightless feeling, and I was falling through a hole in the ground—I'd broken through something like a thin sheet of ice. But there was nothing underneath it!

I was able to turn on the suit light as I tumbled down, but all I saw was a glimpse of the dog spinning around beside and then above me.

It seemed like a long time, but I guess I didn't fall for more than a few seconds. I hit hard on my left foot and heard the sickening sound of a bone cracking, just an instant before the pain hit me.

I lay still, bright red sparks fading from my vision while the pain amped up and up. Trying to think, not scream.

My ankle was probably broken, and at least one rib on the left side. I breathed deeply, listening—Paul told me about how he had broken a rib in a car wreck, and he could tell by the sound that it had punctured his lung. This did hurt, but didn't sound different—and then I realized I was lucky to be breathing at all. The helmet and suit were intact.

But would I be able to keep breathing long enough to be rescued?

The suit light was out. I clicked the switch over and over, and nothing happened. If I could find the dog, and if it was intact, I'd have an extra sixteen hours of oxygen. Otherwise, I probably had two, two and a half hours.

I didn't suppose the radio would do any good, underground, but I tried it anyway. Yelled into it for a minute and then listened. Nothing.

These suits ought to have some sort of beeper to trace people with. But then I guess nobody was supposed to wander off and disappear.

It was about four. How long before someone woke up and noticed I was gone? How long before someone got worried enough to check, and see that the suit and dog were missing?

I tried to stand and it wasn't possible. The pain was intolerable and the bone made an ominous sound. I couldn't help crying but stopped after a minute. Pathetic.

Had to find the dog, with its oxygen and power. I stretched out and patted the ground back and forth, and scrabbled around in a circle, feeling for it.

It wasn't anywhere nearby. But how far could it have rolled after it

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hit?

I had to be careful, not just crawl off in some random direction and get lost. I remembered feeling a large, kind of pointy, rock off to my left—good thing I hadn't landed on it—and could use it as a reference point.

I found it and moved up so my foot was touching it. Visualizing an old-fashioned clock with me as the hour hand, I went off in the 12:00 direction, measuring four body lengths inchworm style. Then crawled back to the pointy rock and did the same thing in the opposite, 6:00, direction. Nothing there, nor at 9:00 or 3:00, and I tried not to panic.

In my mind's eye I could see the areas where I hadn't been able to reach, the angles midway between 12:00 and 3:00, 3:00 and 6:00, and so on. I went back to the pointy rock and started over. On the second try, my hand touched one of the dog's wheels, and I smiled in spite of my situation.

It was lying on its side. I uprighted it and felt for the switch that would turn on its light. When it came on, I was looking straight into it and it dazzled me blind.

Facing away from it, after a couple of minutes I could see some of where I was. I'd fallen into a large underground cavern, maybe shaped like a dome, though I couldn't see as far as the top. I guessed it was part of a lava tube that was almost open to the surface, worn so thin that it couldn't support my weight.

Maybe it joined up with the lava tube that we lived in! But even if it did, and even if I knew which direction to go, I couldn't crawl the four kilometers back. I tried to ignore the pain and do the math, anyhow—sixteen hours of oxygen, four kilometers, that means creeping 250 meters per hour, dragging the dog along behind me . . . no way. Better to hope they would track me down here.

What were the chances of that? Maybe the dog's tracks, or my boot prints? Only in dusty places, if the wind didn't cover them up before dawn.

If they searched at night, the dog's light might help. How close would a person have to come to the hole to see it? Close enough to crash through and join me?

And would the dog's power supply last long enough to shine all night and again tomorrow night? It wouldn't have to last any longer than that.

The ankle was hurting less, but that was because of numbness. My hands and feet were getting cold. Was that a suit malfunction, or just because I was stretched out on this cold cave floor? Where the sun had never shined.

With a start, I realized the coldness could mean that my suit was losing power—it should automatically warm up the gloves and boots. I opened my mouth wide and with my chin pressed the switch that ought to project a technical readout in front of my eyes, with "power remaining," and nothing came up.

Well, the dog obviously had power to spare. I unreeled the recharge cable and plugged its jack into my LSU.

Nothing happened.

I chinned the switch over and over. Nothing.

Maybe it was just the readout display that was broken; I was getting power but it wasn't registering. Trying not to panic, I wiggled the jack, unplugged and replugged it. Still nothing.

I was breathing, though; that part worked. I unrolled the umbilical hose from the dog and pushed the fitting into the bottom of the LSU. It made a loud pop and a sudden breeze of cold oxygen blew around my neck and chin.

So at least I wouldn't die of that. I would be frozen solid before I ran out

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of air; how comforting. Acid rush of panic in my throat; I choked it back and sucked on the water tube until the nausea was gone.

Which made me think about the other end, and I clamped up. I was not going to fill the suit's emergency diaper with shit and piss before I died. Though the people who deal with dead people probably have seen that before. And it would be frozen solid, so what's the difference. Inside the body or outside.

I stopped crying long enough to turn on the radio and say goodbye to people, and apologize for my stupidity. Though it's unlikely that anyone would ever hear it. Unless there was some kind of secret recorder in the suit, and someone stumbled on it years from now. If the Dragon had anything to say about it, there would be.

I wished I had Dad's zen. If Dad were in this situation he would just accept it, and wait to leave his body.

I tipped the dog up on end, so its light shone directly up toward the hole I'd fallen through, still too high up to see.

I couldn't feel my feet or hands anymore and was growing heavy-lidded. I'd read that freezing to death was the least painful way to go, and one of my last coherent thoughts was "Who came back to tell them?"

Then I hallucinated an angel, wearing red, surrounded by an ethereal bubble. He was incredibly ugly. ■

To be continued.

The only books that influence us are those for which we are ready, and which have gone a little farther down our particular path than we have yet got ourselves.

—E. M. Forster

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Science Fact

The World's Simplest Fusion Reactor Revisited

Tom Ligon

Analog published my fact article "The World's Simplest Fusion Reactor, and How to Make It Work" in the December 1998 issue[1]. Those of you who read it probably wonder if anything became of the technology and project I described. Alas, for many years, requirements for confidentiality prevented me from saying any more about it. But things have changed, and I can now tell you the good news.

I'll save the best news for later, and just start you out with the *very* good news.

To bring you newer readers up to speed, the article described a method for making hot fusion that was championed by Philo T. Farnsworth, one of the inventors of television, back in the 1950s and '60s. The device, the fusor, which he invented and Dr. Robert Hirsch improved upon, was an electrostatic particle accelerator that converged fusion fuel ions at the center of a spherical vacuum chamber, where they tended to collide head-on. While this little reactor had shortcomings that prevented it from ever reaching breakeven,

[1] Tom Ligon, "The World's Simplest Fusion Reactor," *Analog Science Fiction and Fact*, December 1998. Updated copy available online at: http://fusor.net/newbie/Ligon-QED-IE.pdf

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it nonetheless showed how easy fusion is once you stop thinking *thermo*nuclear and realize that it is particle velocity, not heat, that triggers fusion. The article went on to describe how easy these things are to build, and suggested they might even make good high school science projects.

Finally, I described the new and improved version of this scheme that Dr. Robert W. Bussard was attempting to build, one that might lead to working power reactors, including power plants suitable for spacecraft. One of the most intriguing things about Dr. Bussard's device is that it would be able to burn a much more desirable fuel, $p\text{-}B^{11}$.

A few months before the article was submitted, I built a crude version of a Hirsch-Farnsworth fusor, which I took to a Tesla Coil Builders of Richmond party put on at the home of noted coil builder Richard Hull. I also carried copies of a draft of the article. While I was standing there in awe of Richard's mighty Tesla coil, the other attendees were falling madly in love with the idea of building their own tabletop hot fusion reactors.

Richard had his first model up and running in a matter of weeks, and several other members of the group were close behind. By the time the article was in print, there was already a small corps of amateur fusor builders chatting away on the internet. They were soon joined by a cadre of new blood inspired by the *Analog* article. And that included some high school students.

One of those students, Michael Li, helped by Richard and his friends, won second prize (and a $75,000 scholarship) in the Intel Science Talent Search in 2003 for his work on the fusor. It is *the* big U.S. science fair. As this is written, at least eight high school students have made measurable fusion using fusors, and two more are getting close.

The amateur effort has now evolved into a powerhouse of talent, centered on a website called fusor.net. And *Analog* can take a lot of the credit for getting the ball rolling. That article reached tens of thousands of science-minded subscribers. And some of you picked up the ball and ran with it. I'm mighty proud of you! And enough of you thought highly enough of the article that you voted for it in AnLab, and it won fact article of the year in the 1999 poll.

The Great News, the Bad News, and the Good News

But that is old news. You want to know where Dr. Bussard's project has led. And that's the great news. In the fall of 2005, he finally worked the bugs out of the little proof-of-concept devices we had been working on, and got one to do some serious fusion[2]. And then there's the bad news. He did that on the last of his research funds, and then had to close the lab. He is presently seeking funds to get the program started again. But the good news in that is, without the previous sources of funds telling us to stay quiet, we can now tell the world.

How Was it Done?

Ah, you notice I'm using the pronoun "we?" Yes, yours truly was right in the thick of it. So let me take you back to 1995, and how I met Dr. Robert W. Bussard. Imagine you're a science fiction author, discouraged with your old job and about to quit and start a consulting business. You get wind of the fact that there's someone in the area working with high vacuum equipment, whose last name is Bussard. So you think, Bussard, vacuum, space, fusion, interstellar ramjets? The inventor of the gizmo be-

[2] "The Advent of Clean Nuclear Fusion: Superperformance Space Power and Propulsion," Robert W. Bussard, Ph.D., 57th International Astronautical Congress, Valencia, Spain, October 2-6, 2006.
http://www.askmar.com/ConferenceNotes/2006-9%20IAC%20Paper.pdf

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hind science fiction classics like *Tau Zero,* the *Ringworld* stories, and many others? Could it be *that* Bussard? So I found the address, dropped by with my newsletter, résumé, and an introductory letter, and knocked on the door of the little office two miles from my home. Nobody was there, but the sign by the door declared that it was the Energy/Matter Conversion Corporation. I slipped my propaganda under the door, smiling as I got the connection to Einstein's famous formula.

Some moments you just never forget. A few weeks later I was sitting at my computer when my business phone rang. I answered eagerly (that thing didn't ring much), and the voice on the other end called himself R. W. Bussard, and wondered if Tom Ligon was available. "I certainly am," I said, "but I just have to know if this is *the* Robert W. Bussard, as in interstellar ramjets?"

"I guess I'll never live that down," he admitted, and then he invited me in for an interview.

We hit it off smashingly, and I instantly recognized that his scheme was a superior version of something I had dreamed up while studying health physics, but never pursued. I went to work for him as soon as he got a little dribble of funding to start back up. I felt like I'd just gotten the opportunity of a thousand lifetimes. If you can only afford one lab rat for your project, I'm the jack-of-all-technical-trades you want, and the company could only afford one lab rat at that time. I worked on the project for about five and a half years. By that time, the project had gotten more funding, and moved out to San Diego. I had agreed to move out there for a year or two to help him get the bigger lab going.

So, what was it like to work at EMC^2? The small, hand-selected technical staff was composed of amazingly talented people, highly motivated by a desire to make fusion, a true dream team. The lab ran on physics and passion. Dr. Bussard is awesome. His career stems from a very early and intense desire to make spaceflight practical, and, with R. D. DeLauer, he literally "wrote the book" on nuclear rocket propulsion. His first degree was as an engineer, and only after developing the first working fission rocket engine did he head off to Princeton to earn his Ph.D. in physics. And, while he is a first-rate physicist, he still has the heart of an engineer and inventor. It was always great fun to watch him at a blackboard, *NRL Plasma Formulary* in one hand, chalk in the other, working problems faster than I could follow them with a calculator.

I should mention a few of the others in this effort. Dr. Nicholas A. Krall is one of the best theoretical plasma physicists ever, and has collaborated on this project from the start. Lorin Jameson is a computer whiz and physicist that put the math of Bussard and Krall into functioning computer programs like EIXL, to analyze the data from the experimental runs and predict performance of larger systems. Later on, Mike Wray, Mike Skillicorn, Ray Hulsman, and Noli Casama were the ones who made the machine that finally worked. And none of this would have happened without EMC^2 president, Dolly Gray, the only person on Earth who can make R. W. Bussard do what he needs to do when he doesn't want to.

Two and a half years after the move to San Diego, he had hired enough talent that I started to feel like excess baggage, so we parted company and I came back to Virginia and found another amazing job. But we stayed in touch, I remain a true believer in the project, and wonder if I'll ever again have a chance to literally save the world. Maybe this article will help.

Basic Principles

Let's review the idea of Inertial Electrostatic Fusion. A little earlier I described a device called a Hirsch-

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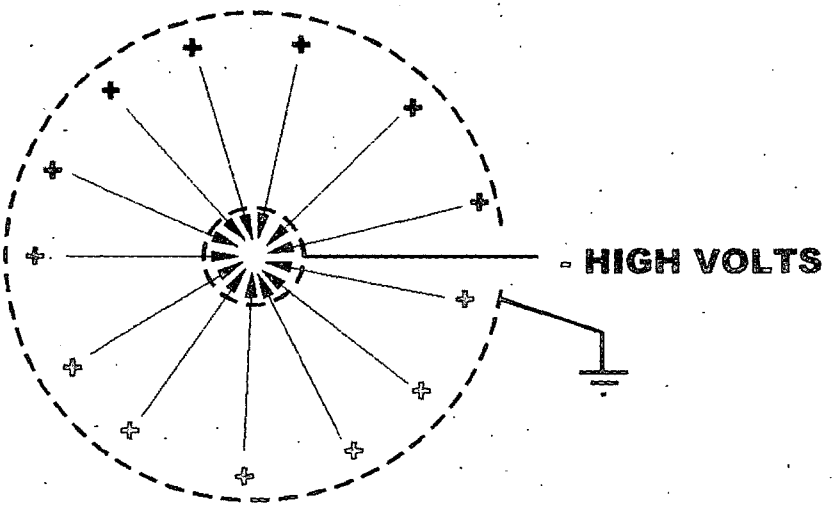

Figure 1. A Hirsch-Farnsworth "fusor" ion accelerator.

Farnsworth fusor. This remarkably simple device consists of an outer vacuum container (typically spherical, but any shape will work) and a spherical inner grid (Figure 1). This device is the descendent of a spherical vacuum tube designed by Langmuir and Blodgette in 1924[3]. If you pump the chamber down to a vacuum, backfill with a trace of deuterium gas, and apply high negative voltage to the inner grid, at the right combination of pressure and voltage, a glow discharge will light off. A glow discharge, also called a Paschen discharge or Paschen arc, is what occurs in a neon sign. Near the low-pressure end of this glow discharge region, with voltages of ten kilovolts or higher, a distinct bright spot can be seen in the center of the fusor's inner grid, and deuterium-deuterium fusion starts to occur. Deuterium ions (deuterons, the + marks) formed near the outer grid or chamber walls are attracted to the inner grid by the high negative voltage. They accelerate toward the grid, which is very open, and most pass on to the center, where density rises rapidly and the chance for fusion goes up with it. That's just how simple fusion is. The fusion reaction is driven by particle velocity, not heat. You don't need to "heat" the fuel by applying a hundred million degree Kelvin torch the way tokamaks or laser fusion approaches run. Plain old high voltage acceleration works fine. In fact, because it is not random, but instead both directed and monoenergetic, it works a lot better than Maxwellian heat.

Alas, the simple machine shown in Figure 1 is flawed. Not every deuteron that shoots into the center of the device manages to collide sufficiently head-on with another deuteron to produce fusion. Some hit and bounce off, and most just miss. In fact, only a few ions produce fusion on any pass. But, if you could build the machine so that the ions conserve energy and can make many passes thru the machine, that wouldn't matter. Eventually they would fuse. But those darned grids are the problem. It

[3] Irving Langmuir and Katharine B. Blodgett, "Currents Limited by Space Charge Between Concentric Spheres," *Phys. Rev.*, 23, pps 49-59, 1924.

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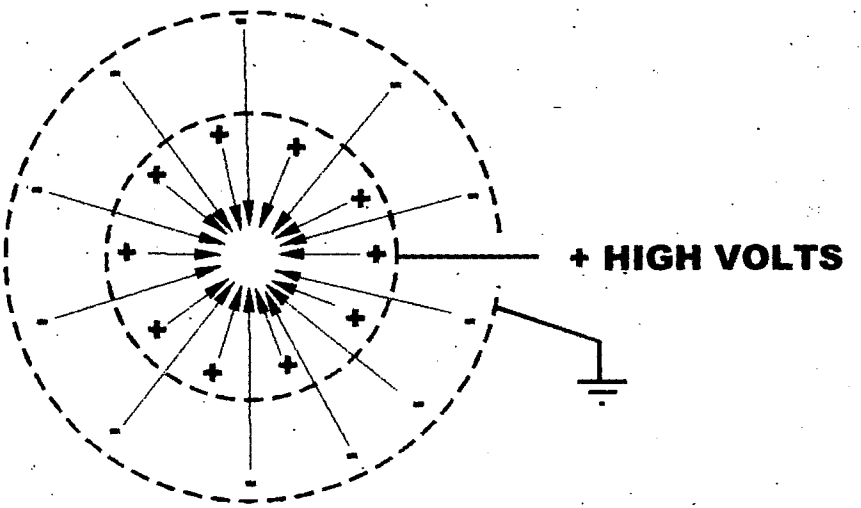

Figure 2. An Elmore-Tuck-Watson electron accelerator with ion accelerating central potential well.

just isn't practical to make them more than about 98% transparent, and the usual figures are more like 90-95%. On every pass, 2% or more of the deuterons will hit a grid wire and be lost, and that's too many to make a breakeven reactor, by a very wide margin.

So that brings us to Figure 2. The Elmore-Tuck-Watson machine[4] is the reverse of a Hirsch-Farnsworth machine. The inner grid is positively charged instead of negatively charged, so it attracts electrons instead of ions. Electrons pass thru the inner grid and converge on the center, pass out the other side, then come back for another pass. The result, at sufficiently high current and voltage, is a very dense region of negative charge in the center of the machine. This is really what you want instead of the negatively charged grid in the Hirsch-Farnsworth machine. If you generate deuterons just inside the inner grid of an Elmore-Tuck-Watson machine, they'll oscillate happily thru that cloud of electrons for a very long time. The electrons and ions are at such high energy that they essentially can't recombine to any significant degree, so, in principle, the ions might make enough passes thru that central region to produce meaningful fusion.

Ah, but what about the electrons? Of course, the machine still has grids, and they still will have about the same limits of transparency, and about 2% or more of the electrons will be lost on every pass. That loss kills this machine as a power reactor.

Dr. Bussard once designed a small tokamak called the "Riggatron" (described as "World's Simplest"). Although he maintains to this day that it would have worked, he was unable to secure sufficient funds to actually build it. Perhaps that was just as well, for it got Dr. Bussard thinking about how to get around the problems

[4] "On the Inertial-Electrostatic Confinement of a Plasma," William C. Elmore, James L. Tuck, Kenneth M. Watson, *The Physics of Fluids*, v. 2, no. 3, May-June 1959.

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plaguing tokamaks.

Tokamaks work by employing intense magnetic fields around a toroidal vacuum vessel. The idea is that ions will spiral around the resulting "lines" of magnetic force that the magnets produce that parallel the inside surface of the torus. Deuterium and tritium ions are thousands of times as massive as electrons, and it takes a really intense magnetic field to make them stay on a line. If you run their density and energy up enough to make fusion, they tend to hop from line to line with each collision until they hit the wall and are lost. The bottom line is that that's why we've been messing with tokamaks for all these decades and we're still not using them to light our homes. The most optimistic estimates say they may be working by 2040, but a more realistic estimate might be post-2100. The Electric Power Research Institute fears they'll never make power economically due to high capital costs and short life.

The New and Improved Elmore-Tuck-Watson Machine

As Dr. Bussard thought about this, he had the thought that it was a shame ions are so much more massive than electrons, because a tokamak would be able to confine electrons at high density far more easily than it would ions of fusion fuel. And then he thought about Hirsch and Farnsworth and the idea that Elmore, Tuck, and Watson had, and a little light went on in his head. He began to wonder if an Elmore-Tuck-Watson machine might actually work if the accelerating grid could be magnetically insulated. And so was born the notion of building a "quasi-spherical" device into which one could inject high-energy electrons. He realized if he took certain geometries, including an equilateral pyramid, a cube, or a dodecahedron, and placed a circular solenoid electromagnet on each face, each pointing with the same pole inward, a suitable electron containment might be achieved. All of these devices are described as Polywell™ designs.

Please understand that this is not a *thermo*nuclear approach to fusion. It does not confine a Maxwellianized plasma in order to produce fusion. The "confinement" principle for the fuel ions here is purely due to their attraction to the electric field produced by the electrons. What that gives us is an ideal form of the Farnsworth fusor, with no grids, within the confines of the magnetic grid. The fusion is more straightforward because the fuel ions converge to a region of high density with the same kinetic energy, sufficient to trigger fusion, rather than depending on some tiny tail of a Boltzmann distribution of energies. Ions not producing fusion have an excellent chance of circulating in and out of this potential well for many passes until they do fuse. The magnets are there strictly for the electrons.

The underlying principle driving the concept is the electron potential well. In order to achieve the desired well depths for D-D fusion, excess electron densities on the order of a million electrons per cubic centimeter are required. It is very important to realize that this is not a multiplier. You *don't* need a *million times more* electrons than ions in the center of the machine, you only need *a million more electrons per cc* than ions. If there are 1.000000×10^{12} ions per cubic centimeter, then 1.000001×10^{12} electrons are sufficient to maintain the well. That suggested a certain robustness of the machine to allow manipulation of ion densities to achieve fusion conditions. The plasma does not need to be overwhelmingly negative; it can, in fact, be *almost* neutral, and the higher the ion density, the closer the plasma is to neutral.

Another important principle is that the potential well is not some static thing. The electrons forming it are in constant, and very vigorous, motion. They pass in and out of the well continuously, as do the ions. While the inner

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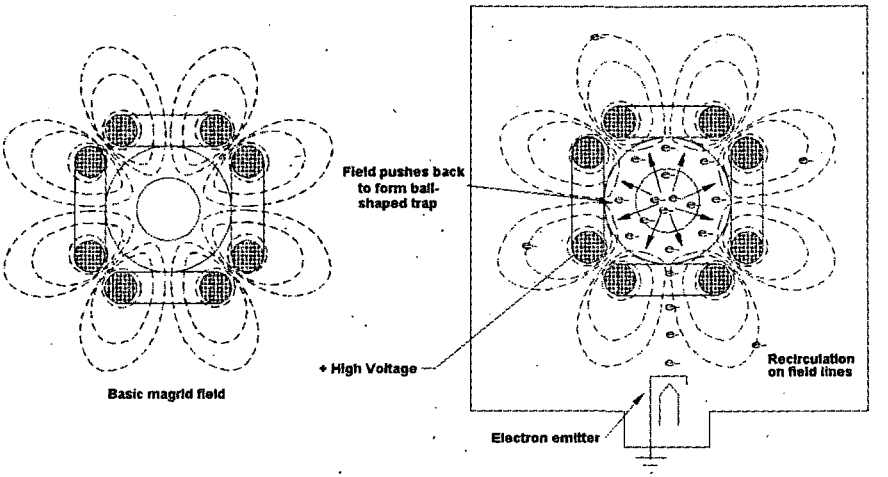

Figure 3. Magrid operation and formation of the diamagnetic trap "ball."

grid of a fusor might classify its driving force as "electrostatic," Dr. Bussard's concept (and for that matter the Elmore-Tuck-Watson machine) is more properly considered "electrodynamic."

Several devices have been built according to one version of this scheme, in which the magnets are mounted on the outside surfaces of a vacuum chamber of the shape described. The first was HEPS, a very large pulsed machine built in the 1980s. I personally assembled and ran PXL1, a miniature of HEPS that could be run for many seconds at a time. Finally WB-5, a scaled-up and improved version of PXL-1, was built and run. None of these were successful fusion machines, but all were quite capable of trapping a lot of electrons, and provided important insights into the trapping mechanism. I won't go into them here because they were not found to be the right approach for making fusion, but the interested reader will find references at the end of the article if they wish to explore these further. Their fundamental flaw is that they cannot recirculate electrons *around* the magnets.

The machines that can produce useful fusion use magnets that operate in the geometries described, located inside the vacuum chamber, and covered with metal shells that tightly conform to the magnets. The faces and corners are open. These are magnetic grids, or magrids, and they are charged to a high positive voltage. They serve the exact same function as the inner electron-accelerating grid of the Elmore-Tuck-Watson machine, except that magnetic fields are used to keep the electrons from being able to actually *hit* the grid. But the magnetic field also turned out to have an additional effect.

When I arrived at EMC^2, WB-1 and WB-2 had already been built and tested. The designation WB describes the shape of the magnetic field inside a Polywell as it "inflates" with large populations of trapped electrons. The resulting field looks just like the plastic toy Wiffle Ball™ on the computer models, the holes corresponding to cusps going thru the magnets' central holes and corners. The toy-ball phenomenon tends to make the population of electrons, and consequently ions, much higher inside the magrid than outside. A high trapping factor is very helpful in achieving fusion conditions inside the magrid without

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having excessive densities of charged species outside the magrid. Ball formation can be visualized by imagining that the magnetic fields' graceful convex hyperbolic arches penetrating into the volume within the magrid are made of foam rubber. High electron populations act more or less like a balloon, and push back the fields, producing a nearly spherical volume, and squeeze the cusp holes to a very small effective diameter. Figure 3 illustrates the nominal magrid field condition and what happens when it operates with a large population of energetic electrons.

WB-1 was made with ceramic donut magnets, the kind used to make audio speakers. These were crudely encased in stainless steel shells, assembled into a cube, and used as a magrid. The best thing about this device was that it was really cheap and simple. The machine did show some electron trapping, and made some pretty glows, but suffered high electron losses due to the fact that magnets of this type have lines of flux going into their faces. This property will affect all permanent magnets and all iron core magnets. The first thing that pops into everybody's mind when they start trying to understand a magrid is that permanent or iron-core magnets might work, but all such devices have cusp-lines going into faces, and are unusable. But this machine would be almost as easy to build as a fusor, and I'll be disappointed if I don't see them start to show up at science fairs.

WB-2, on the other hand, was built of six copper-wire electromagnets, on square cross-section spools welded together at the corners to make a square box. Although small, WB-2 was the right general idea, and it turned out to be a vigorous electron trap. I did a large number of test runs with it, as we tried to increase both drive voltage and magnetic field strength. We even tried it with deuterium gas to see if it could be coaxed to make a little fusion. Per G. Harry Stine's axiom that the tests are not over until the prototype is destroyed, WB-2 blew a coil when we pushed it to about 4.5 kilovolts and a couple of kilogauss. It was a brave little machine, but it was too small for fusion (proving that at least that much of the mathematical models were correct).

Next we built WB-3, which was simply WB-2 scaled up to double the magnet diameters. While it did show signs of trapping electrons aggressively, and lit off all the spectacular effects seen in WB-2, it just never seemed to want to "clean up." Every time we cranked up the voltage past about half the potential needed to make deuterium fusion, it seemed to generate huge quantities of hydrogen gas, swamped out the potential well, and lit off the whole interior of the machine with a bright glow. WB-3 did serve as a good platform for testing several new instruments and ionization methods. And, had we run it with deuterium-tritium, it very likely would have made measurable fusion. WB-3 was capable of running at about half the voltage needed for D-D fusion for a fairly long time before the big glow set in, and is one of the reasons I'm sure these machines are capable of running steady-state.

I left the company just as the finishing touches were being put on WB-4, a very nicely put-together machine about 50% larger than WB-3, made with water-cooled coils, and with elegantly fabricated magnet shells that were sealed up so that outgassing from the insulated copper coils was no longer a problem. They had high hopes for WB-4, and they were, in fact, able to coax some fusion from it, although at far lower levels than hoped for. It shared some of the problems with WB-2 and WB-3. It lost more electrons than it was supposed to, and tended to generate excessive gas when run hard. That excessive gas, in turn, often triggered a Paschen discharge between the magrid and the outer Faraday cage and chamber walls, that same

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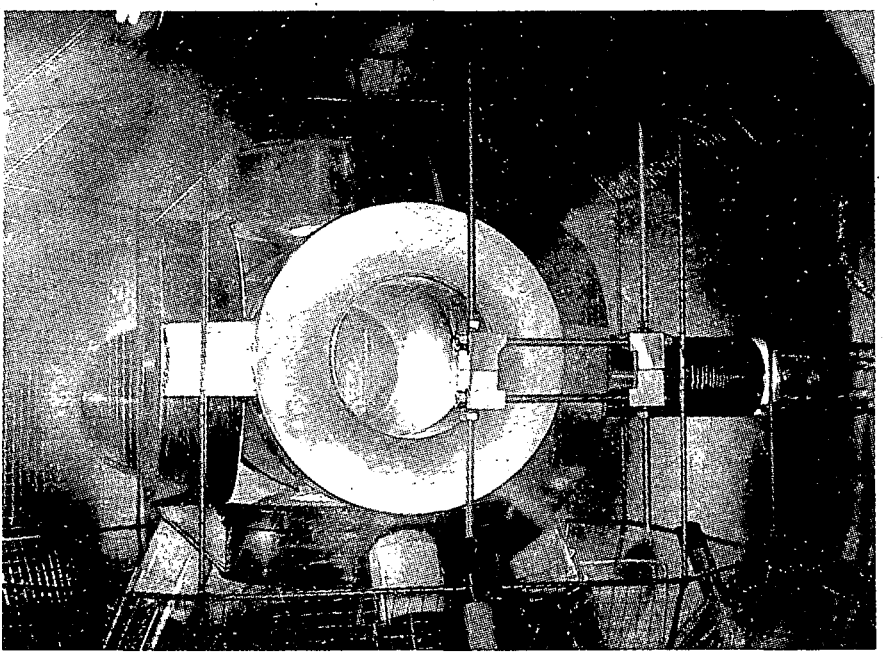

Figure 4. WB-4 in operation.

bright discharge the earlier machines tended to generate. A Paschen discharge is what makes most amateur-built fusors run, but in a magrid machine, it shorts out the high voltage supply driving the electrons, so it must be avoided.

At several points in the development of these machines, Dr. Bussard described to me a problem he suspected might be plaguing them. WB-2, -3, and -4 were all assembled from six magnets whose cases were welded at four spots on each case to form a rigid cube. Each point where they touched was something he called a "funny cusp." In principle, we knew that magnetic field lines penetrated these points, much like the lines that entered the faces on the solid-state magnets of WB-1. However, the hope was that, since this phenomenon really was just a short line, and since lines have no area, it really was not important. Also, with two magnets touching, those points had the highest magnetic field strengths in the machine, which we hoped would make them more prone to act as magnetic mirrors, which also insulate. But what these three machines had been whispering in our ears was that the funny cusp might not be so trivial after all. And the other thing these machines had in common was that their magnets were made on square cross-section spools. The magnetic fields produced by the magnets were not square, though, so that meant lines of magnetic force tended to cut across the corners, making another loss path.

Alas, it was finally concluded that the maximum field strength WB-4 could produce running continuously and cooled, about 3 kilogauss, was not good enough, and it was not going to be possible to push any harder with cooled magnets of the sizes possible at that facility. The scaling law said the effectiveness of the machine should scale as B^4R^3 (magnetic field strength to the 4^{th} pow-

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er, times radius cubed), and at the higher field that was needed, even pumping ice-water under pressure into the coil was going to produce steam in short order. That would stop the water flow. At that point, it became obvious that making serious fusion with the little machines required very short-pulsed operation of the magnets. There was no question that cooled magnets would work with larger machines, with radii on the order of 1.5 meters, but those were not going to fit in the vacuum chambers available, much less operate with the limited power available.

They even contacted the best superconducting magnet maker in the world, to see what it would take to build a superconducting magrid. It turned out, for the little machines with a diameter of under half a meter, it just was not practical. The structure of the magnet required would have an inner superconducting core soaked in liquid helium, a vacuum jacket around that, a jacket of liquid nitrogen encasing that, and another vacuum jacket around that, all with a well-thought-out structure to minimize thermal leaks while maintaining strength against the enormous mutual repulsive forces of the magnets. At a larger scale, he saw no problems, but he could not do it as small as was needed.

Simultaneously with the tests of WB-3 and WB-4, two other machines were run with a configuration we called MPG. The simplest to describe is MPG-1. This machine was formed from a length of copper tubing bent so that it formed a single-turn magnetic structure approximating the WB-3 size and form, a truncated cube (a cube with the corners cut off). MPG-1 was limited to fairly low magnetic field strength, but that was partly offset by the fact that the magrid it formed didn't have much area to start with. Furthermore, the conductor was round and so the magnetic field it produced circled it cleanly. And finally, the conductor was spaced so that it never touched itself, and the result was that it had no funny cusps.

And darned if that simple piece of hardware store tubing didn't manage to make a little fusion!

It turned out that the electron losses and the mysterious generation of hydrogen gas were of the same cause. In an ultra-high-vacuum chamber, it barely takes a trace of gas to raise the pressure by a factor of a thousand or more. Electrons bombarding the magrid case corners and funny cusps were not only being lost, they were digging out hydrogen buried in the metal. That hydrogen diluted the fusion fuel, sometimes so greatly that they couldn't produce fusion even when they had a good potential well depth. And the abrupt increase in neutral gas flooded the area between the magrid and the chamber walls, and produced Paschen discharge, effectively shorting out the power supply driving the electron acceleration to the magrid.

Dr. Bussard had resisted building pulsed machines, knowing that what we really wanted were machines that could run continuously, or at least for seconds at a time, but finally gave in when the limits of magnet cooling at the available size was apparent. As a result, WB-4 finally produced neutrons at a rate of about a million per second when run at higher fields for very short times, in a pulsed mode. But it was still plagued by excessive electron losses and all of the problems that caused.

And Finally, The Solution!

At last, he realized that they had to build a machine that had the right structure, even if the size and budget requirements meant it must be uncooled and intended only for pulsed operation right from the start. Time was running out. The stubborn loss mechanisms had dragged the program out longer than intended, and the source of funding was about to be shut off. They finally realized the right way to build a magrid, but had to do it in haste. The result was a design called WB-6, and it was one gor-

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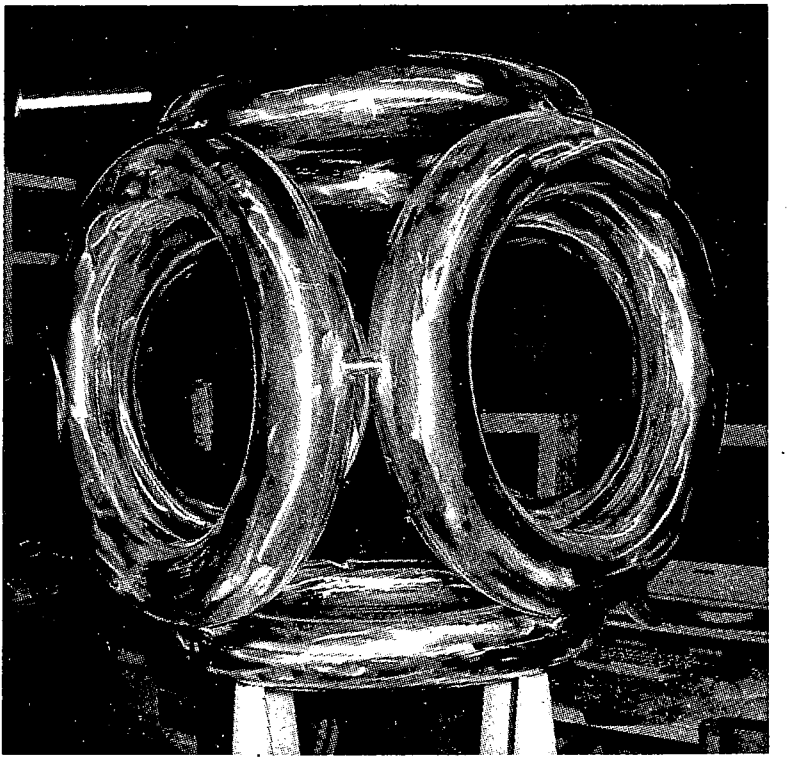

Figure 5. WB-6, the gorgeous piece of hardware that finally did the trick.

geous magrid. One day that thing should be set up with spotlights on it at the entrance to a fusion museum. It is that pretty, and it is that important. The magnet cases are circular-cross-section toroids. Instead of touching, they are spaced apart by a few electron gyroradii. Electrons don't actually follow magnetic field lines, they spiral around them, at a radius determined by the field strength and their kinetic energy. By spacing the coils apart to clear this spiral, the funny cusp is eliminated, and the electrons slip past the grid instead of impacting it. This was, at last, a magrid of the proper form. Figure 5 is a photograph of the finished magrid before installation, and figure 6 illustrates the critical difference between this machine and the earlier magrids.

Pretty though it was, it had limitations. The coils were wound from plain varnish-insulated magnet wire, with no cooling mechanism. Like WB-2 and WB-3, the wire was going to get very hot, very fast. The tests would have to be quite short. Also, realize that the configuration of coils on any Polywell produces mutual repulsion. The coils experience high forces as they press against their containers attempting to get away from each other, and the individual windings also tend to mutually repel. The WB-6 magrid, built from wire meant for more ordinary applications, was destined for abuse. Both of the previous magnet-wire machines had reached end of life due to coil blowouts, and this one was going to be hammered even harder.

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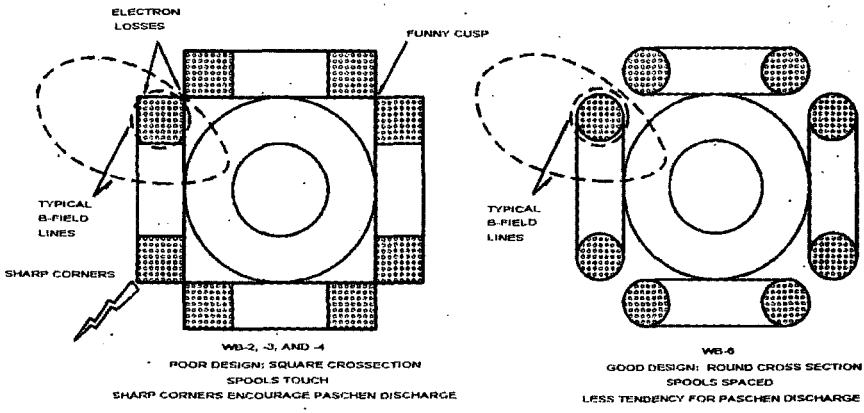

Figure 6. The flawed design of WB2, 3, and 4 was replaced by the good design of WB-6, shown on the right. This greatly reduced electron losses, and allowed the machine to validate the concept.

Another limitation was apparent. Scaling information generated by the other machines revealed that the drive power requirements for this device exceeded the power available to the little light industrial bay that housed the lab. The previous experiments had been bumping up against this limit all along. Typically, we had to use huge battery banks to operate the magnets, as we didn't have the power to run the magnets and high voltage supplies simultaneously. But WB-6 was going to require more electron beam power than the building could provide. It would have to be driven from a large capacitor bank. The capacitor bank could only deliver current for a very short time, with no current regulation in case of Paschen breakdown.

One final problem limited this machine. With so much effort needing to go to perfecting the basic magrid electron trapping performance, carefully metered ion production was beyond the scope of the program. A practical fusion machine is going to need something akin to a carburetor to produce ions, with no neutrals, in the right quantity and location. Fuel to WB-6 was metered by what amounts to an eye-dropper, a "puff-gas" system, which delivered a pulse of neutral deuterium to the inside of the magrid. Ion formation in this device was not produced in as well-controlled a manner as might be desired, although it did work well enough for the purposes at hand. A byproduct of this method of introducing fuel was that Paschen discharge tended to occur between the magrid and the outside walls about 0.5 to 2 milliseconds after the pulse, the time it took any un-ionized gas to migrate to the area outside the magrid. Had this particular puff-gas system been capable of turning off after the initial pulse, this could have been avoided, but the machine had to be built with what was already on-hand. Once the puff was started, gas would continue to flow into the machine until the small reservoir was exhausted.

Following a number of preliminary non-fusion runs at reduced power to characterize the machine's electron trapping properties, four tests of this machine were run in early November 2005 in an attempt to produce fusion. The

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drive voltage was approximately 12.5 kV in most of the runs, with a resulting expected potential well depth of about 10 kV. The tests were actually run several days after the lab had officially closed, and produced a few neutron counts each. One additional test threw caution to the wind, hammering the device harder than ever before, and that ended the predictably short career of WB-6. This magrid, too, satisfied G. Harry Stine's axiom. The last test pushed it too far, and blew a coil. And so they sadly closed down the lab, before even having a chance to analyze the data.

A month later, the data were finally analyzed, and they discovered that the relatively few neutron counts produced, corrected for the counting efficiency and the geometry of the test (13,000 neutrons per count), and the fact that there are two fusions for every neutron in the D-D reaction, showed that nearly a hundred thousand fusions were produced in about a quarter of a millisecond! That's a rate of roughly half a billion fusions per second. The low count meant that the number could not be stated with precision, but it was certainly statistically significant enough to establish the order of magnitude. And the burst of neutrons repeated on each of the four tests, right where the potential well was right for fusion.

One of the things that amazed me when I learned it was that WB-6 actually ran at a considerably lower magnetic field strength than WB-4, and yet still outperformed the more robust machine by orders of magnitude. The improvement was not due to boosting the magnetic field strength. The improvement was due to the subtly improved geometry. The other thing that amazed me was the low drive voltage.

By comparison, a Hirsch-Farnsworth fusor running straight deuterium at ten kilovolts produces neutrons, but at a level so low as to be barely above background. My own fusor (presented at the PhilCon and LepreCon science fiction conventions circa 1998-1999), which I ran with EMC^2's neutron counters, produced around 3000 fusions per second at 18 kV, and I was hard pressed to count anything above background at 10-13 kV.

Robert Hirsch reportedly managed about a billion fusions per second once[5], but that required pushing his fusor to 150 kV. And for a rate that high, he used deuterium and tritium, a much easier fuel mix for producing fusion. In spite of the relatively few counts, crude deuterium metering, unregulated pulsed power, and small size, WB-6 was making fusions like crazy.

So what does that prove? Did WB-6 reach breakeven? No. But it demonstrated that, once the configuration of the machine was correct, it does, indeed, produce fusion at a rate in line with the models. The data said the machine was, at last, working properly, around three orders of magnitude better than WB-4. The fundamental problem was fixed.

And the models say that the reactor output will scale as B^4R^3. Power gain scales as B^4R. If the magnetic field can be made stronger in proportion to machine radius, that would mean output increases as the 7th power of radius, and power output with the 5th power of radius. If this is even vaguely close to being correct, then at some modestly larger scale, this type of reactor is *virtually assured* to produce net power. And Dr. Bussard says the results of the tests of WB-6 put that point at a radius of about 1.5 meters for a deuterium machine, and 2 meters for p-B^{11}.

At a radius of 1.5 meters, cooled copper magnets of the required field strength and capable of continuous operation are practical. It is also at about that size that superconducting magnets become practical for building magrids, and superconducting magnets make

[5] "Inertial-Electrostatic Confinement of Ionized Fusion Gases," Robert L. Hirsch, *Journal of Applied Physics*, v. 38, no. 11, October 1967.

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possible much stronger magnetic fields, which the model says tremendously improve performance. While one could imagine spending some years sneaking up on a net power version of this technology, it is apparent that very little is to be gained by doing so. Machines much smaller than 1.5 meters will still have to be run for very short durations, not the continuous operation needed for a working technology. And the size described for net power is not an extraordinary effort. Dr. Bussard estimates about $150 million for a D-D machine, and $200 million for a p-$B^{11}$ machine. Now, we all know that estimates are estimates, and going over-budget is a long-standing tradition in technical projects, so let's just suppose for a minute that Dr. Bussard is wrong by a factor of five. That would put a p-B^{11} demo reactor at a billion dollars, to demonstrate a technology to save the world. And let's say he is low by a whopping and exceptionally unlikely factor of 50. That would put the program at $10 billion. That would still be a fraction of what has been spent over the last few decades on mainstream fusion research.

The problem is *not* that too much money has been spent on fusion efforts to date. The world spends something like *five trillion* dollars a year on energy, and an R&D effort of a couple of billion dollars a year on a better alternative, over a decade or so, is hardly an unreasonable expenditure if the probability of success is high. If anything, fusion is under-funded. So under-funded, in fact, that existing programs jealously guard their budgets, and the result is some very ugly politics that make it difficult for competing ideas to get a fair chance.

I admit that I think the present tokamak program is a dead end, and Dr. Bussard does not make a secret of the fact he also believes it. The majority of the public probably thinks the same thing, after decades of promises that always seem to be 30 years or more away from bearing fruit. But, in fact, tokamak research has developed or proven most of the technologies needed to build electrodynamic fusion machines, and has even explored tapping some fusion power using direct conversion from charged particles. Remember, Dr. Bussard's concept springs from the realization that a tokamak would easily confine electrons. The proposed reactors would be a small fraction of the physical size of the ITER tokamak, and the technology to build them should be far less challenging. Cost of machines like this tends to scale with size, and comparing the size of Dr. Bussard's proposed machines to the cost and size of ITER suggests that his cost estimates should be pretty good. Nothing entirely new and mysterious needs to be done, we just need to decide to put the pieces together and *do* it. At this point, the challenge is engineering.

And this little fusion program knows where to go. The intent is clearly not to sneak up on fusion a little at a time over many decades, the intent is to target a breakeven demonstrator on the first shot, which could be built in a decade, or even far less if it had the right commitment. When that reactor is built, we'll quickly know if it is a success, a very near miss that needs one more attempt, or hopeless.

What Is This Pie-In-The-Sky p-Whatever?

Let's examine p-B^{11} fusion fuel. What is it, and how realistic is it?

Most fusion efforts expect to burn a mix of deuterium and tritium. The reaction produces most of its energy from neutron emissions, which tend to limit life of the reactor and render the whole structure radioactive. This might be worthwhile if nothing better can be found, compared to the adverse environmental problems of burning fossil fuels, but it is hardly ideal. It is the fusion fuel you usually hear about because it is, by far, the easiest reaction to produce, and it is the only fuel system with any chance at all of making net power from

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tokamaks, laser fusion, and the like. One look at the reaction cross-section versus initiating energy graphs will show you why they don't consider p-B^{11} for tokamaks. The "temperature" it would take to trigger the p-B^{11} reaction in a system operating on Maxwellian heat is vastly higher than for D-T. Expressed in Kelvins, the "temperature" required would be nearly 6 *billion* degrees!

Nevertheless, the p-B^{11} reaction is, and has been for decades, on the "short list" of fusion fuels. Why, if it is so much harder to burn? For one thing, it is remarkably clean. The reaction results in three alpha particles, which, recombined with electrons, are plain old helium. Breathe the waste product of this reactor, and the worst that happens is you talk like a duck for a few seconds. The reaction produces almost no neutrons. Natural boron is 80% B^{11}, it is abundant, and is somewhat toxic. This reaction turns a toxin into an inert gas.

The way the energy comes off has always been attractive. Alpha particles have a charge of +2. The first particle carries 43% of the reaction energy, and comes off at 3.76 million electron volts. The other two alphas come off at around 2.46 million electron volts each (skewed somewhat by the velocity of the intermediate particle). If you wanted to make an alpha with 3.76 MeV of energy, you would knock both electrons off a helium atom, and accelerate it with an electric field of 3.76/2 = 1.88 million volts. To get that energy back, simply decelerate that alpha against a 1.88 million volt field, let it kiss gently into a metal plate as it comes to a stop, and it will produce two electrons of current at that voltage. This has been done on a small scale using radioisotopes, and it is very simple to do. Since virtually all of the energy from this reaction comes off as alphas, and since their energies are relatively close together, it should be possible to devise a method of doing the same thing with the products of the p-B^{11} reaction. The principles are straightforward, although one can bet the engineering will not be trivial. But the benefits of doing it this way are enormous. Even the klutziest approach, setting the decelerating potential at 2.46/2 = 1.23 million volts, would presumably recover something like 85% of the energy. Considering that any nuclear reactor that generates its power as heat will wind up running steam turbines that waste 2/3 of the energy, this is a stunning technology. The environmental benefit of avoiding all that waste heat, the economic benefits of avoiding large cooling towers, and implications for lightweight space propulsion systems all make this efficiency highly desirable.

If this works, it has got to be the greenest technology to come along since photosynthesis.

But can an electrodynamic fusion reactor burn boron? If the models are right, yes, and surprisingly easily. Boron has five electrons. Knock them all off, and the nucleus has a charge of +5. That means an electrostatic or electrodynamic acceleration system will work five times as hard on that nucleus as it would on a proton of charge +1. The net result is that one only needs a potential well depth of something like 100-150 kilovolts. So build the machine a little larger and run it at higher voltage, and it should be straightforward.

But is that "should be" a risk? Well, let's say we build a machine to try the p-B^{11} reaction, and find out the estimate is off and it won't hit breakeven. Well, you've just built a machine that should burn D-T or D-D with ease. If it were my choice, with the cost of the demo boron-burning reactor only about 1/3 higher, I'd design for p-B^{11} without a second thought.

Saving the World

Energy touches almost every facet of civilized life. In the final analysis, energy, raw materials, and human talent are the foundations of prosperity. We receive frequent little reminders of this every time fuel prices spike, conflict breaks out in an oil-rich area, or new environ-

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mental news makes the headlines.

Global warming is a hot topic these days, and it should be obvious that p-B^{11} fusion would be an elegant solution. This sort of power source would make hydrogen a practical fuel for transportation. Other issues are pollution from burning fossil fuels, oil as a catalyst for war, Iran enriching uranium for "peaceful" purposes, North Korea breeding plutonium for bombs, struggling economies around the world, and the whole question of what the heck do we do when oil gets scarce, not too far in the future? And how many of you *Analog* readers would like to see fusion-powered spacecraft?

The world needs a technology that can be brought on line in the next few decades (preferably a lot sooner), compatible with existing power grids, affordable, compact, non-polluting, incapable of making nuclear weapons, and able to be used worldwide. If p-B^{11} fusion can be made to work, I cannot imagine a better overall solution to the world's energy problems.

Unfortunately, Dr. Bussard is no spring chicken, and he has reached a point in his life where he really needs to turn this over to someone else. He is willing to help where he can, but this project needs young blood. Young, *passionate* blood.

It is my hope that, by the time this article is in print, a deal will already be in effect to get the program back underway in earnest. For the interim, Dr. Bussard has set up a non-profit organization called EMC^2 Fusion Development Corporation, under the New Mexico Community Foundation (NMCF), at 343 E. Alameda, Santa Fe, NM 87501.

But who will pick up the full program? The United States government could easily fund it. But are they the most logical to run it? The Department of Energy is running a tokamak agenda, and has a vested interest in continued funding of that program over long careers. A number of people it that field would love nothing better than to be put in charge of electrodynamic fusion to prove it won't work.

A company with the resources, knowledge, and desire to pull this off might be better than a government agency. Perhaps this would be with government funding, or perhaps just as a private investment. The sum of money involved is well within the capabilities of good old-fashioned private enterprise. For that matter, there are probably a few hundred individuals in the country who could fund it if they so chose, perhaps sacrificing an especially nice yacht.

Do I expect somebody to read this article and just pull out their checkbook? That would be nice, but I don't think this should be undertaken by an idiot. After all the decades of fusion promises, skepticism is a sensible reaction. What I hope this article does is to make a few of the right people curious enough to really get down and look at the data. They'll want to know just why a handful of neutron counts from a few short tests are so significant. They'll need to see the math codes, and understand if that B^4R^3 scaling is really solid. They'll want to meet Dr. Bussard and find out for themselves if he's a scammer or the real deal. They'll need to do their homework.

They'll want to consult some experts. There will be no shortage of experts who will tell them it can't be done. And there will be a few who will tell them why it *can*.

And if they come and talk to me, I'd tell them if I had two hundred million bucks lying around, this project would be funded already. ■

Readers are also referred to:

"Should Google Go Nuclear?" Transcript of a talk by R. W. Bussard, by Mark Duncan, http://www.askmar.com/ConferenceNotes/Should%20Google%20Go%20Nuclear.pdf

"Should Google Go Nuclear? Clean, cheap nuclear power (no, really)." Google Tech Talks, November 9, 2006. Online video lecture by R. W. Bussard.

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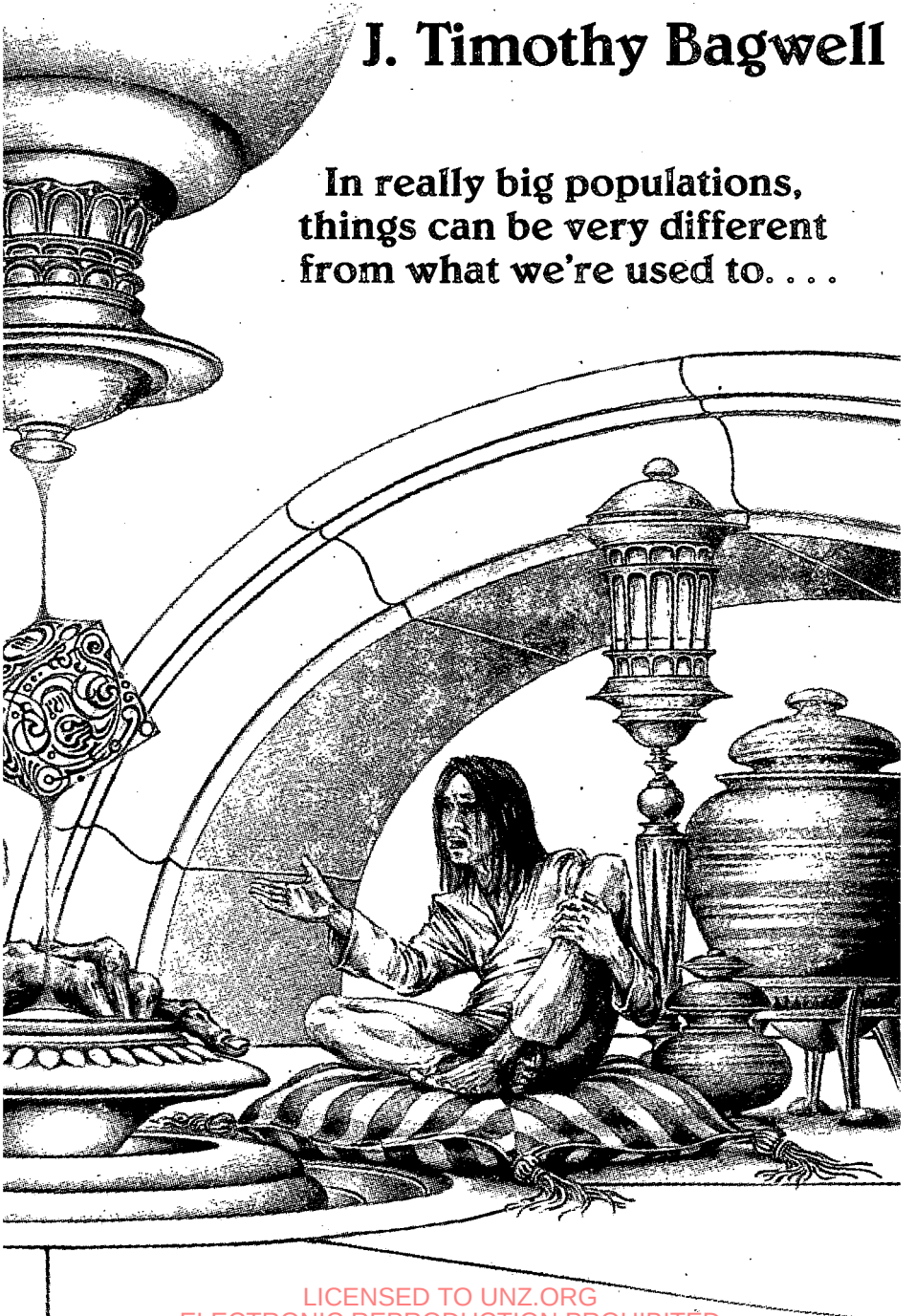
Tangible Light

J. Timothy Bagwell

In really big populations, things can be very different from what we're used to. . . .



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Prashan was running out of time. He had put off carrying out his father's dying wish for him to submit to a phenome analysis at the Hall of Records in the Great Library at Polity. He had put it off until only one day remained of the research carrel reservation procured at such enormous expense. Prashan's intention had been to put it off indefinitely.

Then earlier that morning he had paid a visit to the library, partly out of nostalgia for the attachments of his old life and partly to celebrate the personal independence that the expiration signified. In the stair tower of the library's east portico he had seen the Taffonetta mosaics. And he had realized with a shock what it was his father had sent him there to learn. Now he had only about six hours to find it out. It was like looking for a needle's shadow in an entire field of haystacks. And apparently the only way to proceed was to get a degree in agriculture.

"You have to bear in mind, Master Chakrapranesh, the scale of the task before you. Try to imagine a population so large that the number of individuals exceeds the number of possible genetic variations; a civilization so old that patterns and records of patterns have accumulated for age upon age, until the records themselves—and the algorithms for accessing them—have become a topography almost too vast to be navigated. I question whether one day will suffice for the purpose you intend."

In his distraction, Prashan felt more than heard the words of the old man, who had leaned very close to repeat his last sentence. His voice's deep cello tones seemed to resonate in Prashan's own vocal cords and its vapory warmth washed over Prashan's face with the vinegary-sweet savor of cashew-fruit chutney.

"Master Chakrapranesh?"

Prashan regarded the ancient Thurkmhen critically. The old man was so tall and thin, like all of his race, that in order to join Prashan in the research station, he had to sit on the floor and fold himself up like a ruler. His pale amethyst eyes were wells of steady patience. Prashan closed his own eyes, which were more the color of wet mahogany, and tried to concentrate on the things of which his companion spoke.

"One day is all I have."

Prashan's father had died of the gutworm six months earlier. What had started three weeks before that as an invisible leech-like niblet attached to the wall of his upper esophagus resembled, near the end, a boa constrictor with its head deep in the man's throat and the blunt end of its tail protruding into his colon. It had started by siphoning off minute quantities of nourishment whenever Prashan's father ate or drank. As the proportion it coopted grew, Prashan's father began to lose weight, even though he consumed more and more. Eventually, the gutworm expanded until it filled and took over the function of the gastrointestinal tract. At that point it took all of the food and let Prashan's father's body survive by consuming itself. When Prashan was summoned for the last time to his father's bedside, the worm was releasing just enough refined nutriment through its glassy skin to keep the man alive until it matured.

There was no cure. By the time Prashan's father had begun to lose weight rapidly, and a diagnosis had been made, it had already become impossible to remove the worm without killing him. He would continue to waste away as the gutworm dissolved and absorbed his bones, and when it no longer needed him, it would slough off his body like an old skin, head for the nearest large body of water, and found the first Earthen gutworm dynasty. Before that could happen—as Gayatri, his father's young

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consort calmly explained to Prashan one fine day in the west garden—the authorities would intervene. His father would be declared legally dead, despite the fact that he would remain alert—the parasite would carefully protect the nervous system until the end because it played an important role in the process of restructuring the host's body—and "the worm," as Prashan's father would then be in the eyes of the law, would be destroyed.

Prashan had not known of the existence of either the parasite or the laws governing its control. Prashan had not known of the existence of very many things, as it turned out.

"May I?" the old archivist asked softly. A long jelaba-sleeved arm snaked out slowly past Prashan's face and touched a small bead of rose-colored light that floated in the dark space before him. A virtual terminus took shape out of thin air, ghostly at first, then solid and substantial looking.

In the faintly glowing cube of Prashan's terminus hovered the beginning of a poem. Prashan had written it more than a year ago, well before any of the craziness had begun, and then typed it earlier that morning on the ghostly keyboard just as a way to try out the virtual hardware. He had found the tactile sensation in the tips of his fingers as they danced on tangible light unsettling.

If it is true that every night you dream

A thousand lives and that whichever one

You wake up in is the one you live that day . . .

The old Thurkmhen jetted some air out of his nostrils and closed his finely veined nictitating membranes like stained glass over his eyes a couple of times. Prashan had gathered by now that this was a way of expressing being pleased.

"Did you write this?"

"Yes. It's not very good. It's only a beginning. I was just trying out the keyboard."

In point of fact, Prashan had never gotten beyond these first three lines, this dependent clause, this half a syllogism. But they held out a promise that he could not let go of.

"May I?" The arm slithered past Prashan's face again. "This might be a good way to illustrate my point." Long, graceful fingers did a tarantella over the ghost of a keyboard. The monitor faded and in its place hovered what looked like a series of vertical playing cards suspended in the air and extending forward impossibly far (given the wall Prashan knew to be there) toward a distant vanishing point. The old man pulled gently on a corner of the first card and it grew into a sheet of vellum. On the sheet was Prashan's poem. Underneath the poem was some more writing in a different language, one Prashan did not recognize.

"What's this?"

"It's your poem beginning."

"I realize that. So?"

"But you did not write it."

"I just told you that I did. Don't you believe me?"

"Yes. But you did not write this one."

"It's the same one."

"It is; it isn't." Prashan recognized a Thurkmhen version of his least favorite Tamil proverb. "This one was written by Hamu Hamubhan Bhamjallah of the edgeworld Savannah approximately . . ." It took Prashan a moment to arrive at the correct figure from the degrees of galactic rotation given.

8500 years ago?

That got his attention.

"But it's identical, word for word."

"Yes. In that sense, it's the same poem. There are many others, obviously, with only minor variations."

"These others lined up behind Hamu's, I take it."

"No." The long fingers flicked the

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top sheet away and the next one came forward and grew larger. It seemed identical in every way to the one before, except that the writing underneath was in a different language from the first. "All of these are identical in every way to the one we just looked at—the one you wrote. That is, they are identical textually. Historically, of course, each has its own context."

"How can they all be in the same language?"

"Shmentanha has been around for a long, long time. It's not limited to a few thousand years in the history of one small planet. Try to get over the notion that there is something unique about you and your culture, Master Chakrapranesh. The galaxy is very old."

Shmentanha, Prashan knew, was Proto-Indo-European. His father had taught it to him from birth, calling it "Old Sanskrit."

Prashan looked at the row of cards, each with his poem written on it.

"How many are there?"

"This search revealed a few over seven hundred. That is really quite remarkable, by the way. It must be a very original beginning for a poem."

"I had thought so."

"Of course, these beginnings lead to quite a number of different poems."

The long fingers danced again and another eleven lines appeared under Hamu's beginning. Prashan sucked in his breath quickly and held it. He had always intended the poem to be a sonnet. To see it completed was gratifying but filled him with a strange sense of loss. The direction Hamu had taken it both surprised Prashan and seemed to him exactly right, an echo of his own thoughts. The old man showed the rest of the next poem. And the one after that. And the one after that. Three played out ideas that Prashan had considered but not settled on. One went in a completely unforeseen direction.

"Of course, this search focused on poetry. The same text may exist under different classifications. And, of course, many people may have written an identical text that never got published. Ah, how many thoughts have been lost to the fire of forgetting!"

"What difference does it make, as long as at least one copy got saved?"

The old Thurkmhen shook his head in the manner of Thurkmhna everywhere, rotating it on the axis of his nose, first clockwise, then counterclockwise, as he squinted at the boy next to him.

"None, if all you care about is the existence of the poem. But what is that? If you care about the existence of the person, then it's everything." The old man hesitated, seemingly aware that he had perhaps overstepped his role. "Would I be intruding if I asked you whether you have a specific research purpose in mind? It might help me to point you in the right direction, if you would like that help. Is there a particular thing you want to know?"

Prashan considered that. *Yes—why my father thought this would be helpful.*

On the morning of his last day on Earth, Gaya had come up behind him silently in the west garden, where he was luring carp to the surface of one of the hydroponics tanks with jacaranda flowers.

"Very romantic, from your point of view. I'll bet the fish would prefer a juicy spider or two." Her voice grew quieter, more intense. "He wants to say good-bye to you."

Good-bye? He had not been prepared for that. He had been waiting for days for his father to summon him for the conversation they must inevitably have in order for affairs to be put in order and Prashan to assume responsibility for his father's estate. Instead, it seemed everyone but Prashan had been in to visit his father, includ-

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ing people Prashan had never seen before.

"Gaya, I'm sorry. . . ."

"Don't be a fool. Go to him."

Prashan's father lay on a mat on the roof verandah, where ribs of sunlight played over his limp body, falling through palm fronds waving in the light breeze like witch healers. There would be no healing for Prashan's father, however. His arms and legs lay flat and useless beside his trunk like stockings laid out to dry. Within the hollow rasp of his breath was another sound, ghostly echoing the first—a dry hiss. This is not my father, Prashan told himself with curious detachment, not my father, not my father, not my father. But it was. And for the first time, ever, Prashan was glad that his mother was no longer alive.

"Prashan. My son."

"Father." Prashan oddly felt nothing.

"I had wanted to help you come to know who you are. That is the prime duty—and great joy—of fatherhood. Now that can never be."

The word *never* cut through Prashan's heart like a scythe swung low and fast, that for a moment leaves the wheat standing, balanced on nothing, before it topples over. He made small talk.

"I had wanted that, too, father. Now I will have to learn this on my own."

Prashan's words were cold, but on the other side of the dam, the waters of anguish were troubled and rising.

"No! That way is too uncertain. I've made other arrangements."

Prashan would have felt dismayed, if he had not been so numb. His father had appointed a guardian for him, even though he was fourteen and could legally inherit or at least administer his father's estate.

"Father, is that what you think of me?"

"Listen. You don't understand. I want you to go to Polity. You leave this afternoon. If you agree, that is. I hereby grant you your majority. You witness?" Shifting slightly where he stood in the corner, his father's old manservant, whom Prashan had not noticed before, nodded solemnly.

Too much was happening too fast. His father's impending death. His majority. These things he had had time to ponder. But did his father mean by "go to Polity" what he thought he meant?

"I'm not going anywhere, before . . . I'm not going to leave you, father."

"Prashan, my beloved and thick-headed son, hear me. Any hour now, Reticulum epidemiologists will show up with my death certificate and all the tools needed for a good old-fashioned drawing-and-quartering. Do you really want to witness that?"

"No, of course not, but how can I leave you to face that alone?"

This was ridiculous. It was as if they were discussing the weather.

"Do you think it would make things easier for me to know my son was watching?"

"But even if I could abandon you, go to Polity? What do you mean?" Prashan knew what the old man meant. He had known it all his life without actually hearing it or admitting it.

"I would rather have you on your own in a strange world knowing who you are than in a familiar place where you are a stranger to yourself. I've liquidated the estate to pay for you to go to Polity and visit the Hall of Records at the Great Library. When you have done what I ask, you will truly be on your own. But you'll have yourself. You may also learn something that will help you to understand the situation of the Earth."

"Liquidated the estate." *Liquidated his inheritance.*

"It will just cover passage to Polity and the work of researching your phenome at the Hall. After that, you'll barely have pocket change. It's the best inheritance I can give you."

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Prashan thought of his father's diplomatic palace, his wealth, his library, his priceless works of art. To his chagrin, he thought also of Gayatri, half mother and half sister to him. "You're free to turn it down. You're free to do anything you want, my son. But you must decide now, because a car is waiting for you, and you have only just enough time to walk to it and ride to the tetherport before the shuttle leaves."

As Prashan's numbness turned into paralysis, several things happened at once. From close behind him, Gayatri spoke in a tone of bitter contempt of which he had not thought her capable.

"I have no desire to become your whore, in case you were wondering."

It was as though she had hit him. Then a man and a woman in white overalls were on the verandah. The woman was holding what looked like an enormous bolt cutter. Words came to him unbidden from memory. *It is necessary to sever the spine just below the cervical vertebrae in order to prevent the parasite from using the host's central nervous system to protect itself.*

"Bind it," the woman breathed in disgust. "We have four minutes to execute this writ."

Prashan's father quickly downed a glass of blue liquid held out to him by the manservant. Prashan later learned that the glass had contained a sedative designed to keep the gutworm from increasing his father's pain as a way of protecting itself. Prashan's father spoke one last time.

"I love you, son."

As if from a great height, Prashan saw himself slowly turned and steered by the old manservant to the waiting car. A scream that might or might not have been his father's was clipped short by the shutting door. Then, still very far away, Prashan watched as the car drove off with him in it and disappeared on a winding road lined with eucalyptus and jacaranda trees.

It was only later that Prashan had wondered what his father meant by "the situation of the Earth." He was leaving it. How could it possibly matter?

The old Thurkmhen had just asked him a question. There was gentleness and compassion in the ancient one's amethyst eyes, but concern and bafflement as well.

"I'm sorry. What did you say?"

The old man looked down at the knees tucked under his chin as if they belonged to somebody else. "I was wondering if you noticed any of the other patrons in this part of the Hall."

"You mean like the woman making the rug?"

"Yes, her for example. She has been coming here every day for over five years. And those persons wearing the black jelabas with yashmaks and face girdles?"

Prashan had wondered about them, but then there were all kinds inhabiting the research carrels.

"Yes?"

"Monks. They belong to an order devoted to the study of phenomology. Their goal is so totally to immerse themselves in their phenome that they cease to exist altogether as a particular manifestation and become the phenome itself. It's a peculiar kind of discipline, but a rewarding one—so I'm told. They claim to be freed from the prison of individuality and to have attained the full realization of the self."

"That's interesting," Prashan observed, trying not to show how uninterested and impatient he felt.

"My point is that they devote an entire lifetime to the activity to which you are proposing to commit an entire day, exclusive of time spent writing poetry."

"You don't think I can do it in a day." It wasn't a question. It was the

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last gasp of hope.

"Young man, I doubt that you or anyone else could master the research instruments in only one day. The novitiate of a phenomology monk is two years."

Prashan sighed. He had originally had three months. If he had followed the course of action set out for him by his father, at the end of that time Prashan would have been penniless, homeless, and friendless in a world whose existence and strangeness he could not have imagined.

At first, Prashan assumed he had been plopped down in a large, unfamiliar city in southern Asia or perhaps Africa. Most people seemed cut out of the same oriental cloth—olive skin, dark eyes, slight figures. Many people spoke languages Prashan could not understand, but a significant number of them spoke a version of "Old Sanskrit." By seeking out the parts of the city where this language dominated, Prashan found he could get by. He decided to focus his attention on securing food and shelter and deal with the problem of where he was later.

But the air smelled—felt—different. And the sky wasn't right. And it wasn't just the color—too much green in the blue—either. The sky wasn't round enough. It was as if the edges, when he could get up high enough to see over some of the buildings, had come unglued and floated up into the atmosphere. The horizon where the blue-green melted into a misty white was impossibly high, as if he were surrounded by distant mountains covered in clouds.

Worst of all was the bone aching heaviness that gripped him soon after arrival. Prashan had no idea what to do if he were ill; therefore, he wouldn't be. But something was very wrong.

Then one day he stopped in front of a shop window, looked inside, and saw a large globe. Instead of the blue and burnt sienna tones he would have expected, the sphere was white with odd patches of red and orange and blue, like a badly frosted cake. As Prashan pondered what the globe could possibly represent—seeing it as some kind of parodic allusion to a real globe—it came to him that it was simply a representation of the world on which he now stood. It was just "the world."

Suddenly the very air felt alien in his lungs, and for several minutes he couldn't breathe without gagging.

The strange horizon was, he later learned, an optical illusion. Polity had nine times the surface area of Earth. It didn't curve enough within the range of vision to be perceptible. One just saw the empty distance at right angles to the sky. And Polity rotated more rapidly than Earth, rapidly enough to make the Politan day only slightly longer than twenty-four hours and to offset the increased gravity a good deal—but not entirely.

Hardly any cherished notion about the human race was true. Prashan learned many things and unlearned many others.

It was not the difference of the new world as much as its similarity that caused problems for him. Other people spoke his language, ate his food, practiced his rituals, shared his desires and fears, and they all did this with perfect indifference to him and his world. What for him was a mind-boggling experience—an encounter between his world and the brave new world before him—was so common, so mundane, so completely and totally understood and anticipated in advance by the society into which he had stumbled that—amazingly—no one paid any attention to him at all. They simply did not see him. Not one thing was left to him that was truly his own.

Surrounded by so much cultural energy and activity and galvanized by so much cultural shame, Prashan soon

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disowned in his heart his personal history, his planet, and the plan foisted upon him by his father. In a few months time, he began to wonder who the person was who he had been when he arrived. Prashan had a good, if modest, life in his little apartment on a shop-lined street in a large commercial district of the city that never ended. It was not so much that he preferred it to his life on Earth as that it had become so much more real to him that he regarded his original mission, if he thought of it at all, as a quaint childhood dream.

But there was another issue too: money. Prashan's father had liquidated Prashan's inheritance in order to finance the stint at the Great Library. Soon after arriving, Prashan had realized that his three months at the Hall—together with a sumptuous hotel/restaurant provision—would cost a fortune even by Polity standards. It would eat up all his resources, and his father had not planned for what would happen beyond that. To keep his promise would be to fritter away his own security. Almost immediately he began to think of ways to convert his luxury accommodations into something more modest and lasting. Prashan decided to forego the visit to the Hall of Records and to concentrate instead on seeing what kind of life he could make for himself on Polity.

The old Thurkmhen rotated his head back and forth along the axis connecting his nose to Prashan's and muttered to himself with polite resignation.

"One day for a phenome analysis."

Prashan looked up sharply. The woolgathering had to stop.

"What is a phenome, exactly?"

The old man seemed shocked for a moment and then almost immediately relieved to have the opportunity to explain something so basic to this lunatic with a timetable.

"Do you understand the concept of a genome?"

Prashan remembered studying the human genome project, which had been completed half a century ago.

"I think so. A genome is everything you need to know to understand how a species of organism is made."

"Precisely. A phenome is everything you need to know to understand how a particular organism is made."

"What's the difference?"

"Imagine a map that has each of the genome variables filled in: male, brown eyes, black hair, olive skin, left-handed, intelligent, introverted, et cetera, down to the last particular detail of the person you are. That is your phenome. Multiply the number of variables per gene into a total number of permutations—that is the total number of phenomes. They're all stored here."

"Nature, but not nurture, right?"

"Nature, and enough histories of nature/nurture dialectic to establish definite patterns and expectations. Throughout the Reticulum and over the course of history there are and have been many people with exactly your phenome—your particular genetic makeup. Records of those people's lives are stored here. By studying those records, you can learn about those people. And in learning about those people, you can learn about yourself."

"Like having a bunch of twins. Or clones."

"Yes, except that most of these twins have already lived their lives and they have done so under an extremely wide range of circumstances. You can learn much from them. Perhaps too much."

Prashan could see how he might personally gain from this experience, given enough time to carry out the process thoroughly. But what was the connection to Earth? The thought reminded him of the Taffonetta mosaics and the horrible thing he had learned

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earlier that morning.

"If you look closely, you can see an image changing," the guide had explained. "For example," he continued, approaching one of the larger and more active disks, "notice how this long cloudbank is approaching the edge of this continent. And notice how the whole thing has rotated to bring these islands into view. They weren't there a moment ago. Isn't it beautiful?"

Prashan had to admit that it was. From any side angle, the mosaics appeared to be solid stone worked with amazing detail. Full on, the stone disappeared and only an image remained. When the viewer moved and the stone reappeared, it seemed to have changed right along with the image.

"There's a camera pointed at every planet in the Reticulum?" asked a tourist.

"Not a camera. A light pump. You're not seeing an image of the planet. You're seeing the planet itself. Or rather you're seeing actual light reflected by the planet, which is all you would see if you were there. You're looking through the network of connections that makes up the Reticulum itself."

Prashan understood something of light-pump technology, or LPT. Not long after his decision to make a go of a life on Polity, at a moment when the fear of impending poverty was strong upon him, he had approached a worker he saw repairing some sort of apparatus in one of the planet-city's unbelievably lofty buildings and started asking questions. A few days later Prashan had convinced the worker's supervisor to take him on as an apprentice, with the stipulation that he would support himself for the duration. Prashan began to learn to service a variety of business and communications devices based on LPT.

LPT, Prashan soon found out, made possible the political unity of the consortium of human planets known as the Reticulum, of which Polity was the capital. LPT enabled Reticulum worlds to communicate across distances that made electromagnetic waves—even in a vacuum—seem to dither and dally. Prashan did not completely understand the physics of LPT and was not expected to, but he did know that it worked in the way fields do. Place a charged particle in an electrical field and the particle acquired voltage—instantly. In LPT the fields in question resulted from the quantum entanglement of particle arrays. Change the quantum state of the particles in one array, and those of the other mimicked the change instantaneously.

Entanglement fields were not fields in the traditional sense, because their ability to impart quantum-state changes was not limited by distance. But entanglement fields did act upon the electrical and magnetic fields that made up EM waves. As a result, LPT could jolly light along like nobody's business.

Hearing a tour guide describe how they were looking at actual light from Reticulum worlds, Prashan had been filled with an inexplicable but burning desire to see the mosaic for Earth. He had been looking for over an hour, and this was now the third tour group surrounding him.

"Excuse me," Prashan gasped, exhausted from ascending and descending the staircase like an angel on Jacob's ladder, "can you tell me where a particular mosaic is located?"

The guide looked Prashan over with some reserve, and then smiled ingratiatingly.

"Of course, young man. Which mosaic would that be?"

Prashan tried to catch his breath and speak in a normal, calm voice.

"The one for Earth."

"Uduth," said the guide confidently as he consulted the bulletin board he

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held in his hand. "Uduth, Uduth, let me see." Prashan waited. All eyes were on him. "Can you describe it?"

Good lord.

"Small," he offered. "Much smaller than Polity. Seventy percent water and thirty percent land. Nitrogen/oxygen atmosphere. Blue sky. Frozen poles."

"Land masses concentrated in one hemisphere or spread out evenly?"

"Evenly."

"Highest peak?"

Prashan did some quick unit conversion. "Ummm, oh yes, 11,400 kshutri. Everest."

The guide strode up the staircase with Prashan on his heels and the rest of his flock close behind. The guide approached a mosaic and announced his discovery to the group at large.

"Young man, the Reticulum name for Uduth is Splinth."

Prashan pushed his way up to the indicated disk.

"That's not it," he murmured.

"Pardon me?"

"That's not it."

"Certainly it is."

"No, it's not," said Prashan much louder than he had intended.

"Well, then, young man, it would seem that Uduth is not a human world." The guide consulted the card again. "Look, there it is in the corner. Splinth is the human world of record."

After uttering these cryptic remarks, the guide moved on, taking his entourage with him. Prashan peered closely at the tiny world in the lower left corner of the Splinth mosaic. There it was—the globe he had grown up learning was all the world. It moved almost imperceptibly, like a small animal, trapped and barely alive.

Prashan sat down on the broad milky stair, put his head on his knees, and wept.

Now Prashan stared at the old Thurkmhen in desperation.

"Please. Can you suggest any way to speed things up?"

The old man wrinkled his nose, grimaced, and flared his nostrils.

"There are ways, but . . . Let me put it thus. Even the phenome monks cannot begin their studies until they have attained majority. It is important to have a well-developed self as a foundation even for the emptying out of the self. Do you understand? If you begin the process too young, it can be risky. It takes a strong psyche to withstand the experience of radical decentering. You see, these other lives are complete—they have achieved their ends. A person who is in early adulthood has most likely not. And one who has not yet attained adulthood—well! Plus you must remember that not every life is as successful as another. Many of your avatars will have been extraordinary personalities. Confronting them can be daunting."

"Are you saying that I won't enjoy the experience or that it could be dangerous?"

"Both are possible. And of course the more you speed up the process, the more potentially unpleasant and dangerous it becomes."

Prashan tried to think of how he might deal with a research problem like this back home.

"Couldn't you just give me a handful of biographies of men with my phenotype and let me read them?"

"I could, Master Chakrapranesh. But consider: you have now half a day. How many biographies can you read in that time? They are long. A book that simply stated the facts of a person's life—when and where that person was born, what position of high office that person rose to, what diseases that person found a cure for, how that person died—would be very short and not very helpful. A good biography gives you a sense of the day-to-day life of a person, the flavor of his or her quotidian existence, and shows you the series of tiny, often false steps

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by which a person becomes the thing that we remember him or her for. It will not help you much to learn that your phenotype tends toward greatness if you do not have a sense of how that development occurs."

"Perhaps I could read just one or two."

"That leads to another problem. It may not be wise to focus only on those avatars of your phenotype that achieved greatness, assuming there to be such, especially for someone as young as yourself."

"Why don't I stand to learn the most from the best examples?"

"Because only a small proportion of even the most promising phenotypes actually realize the greatness for which they have the potential. You know, I am sure, how hard it can be for a young man to have a very successful father. It can be intimidating, hard to live up to, frustrating constantly to have to measure yourself against." Prashan thought ruefully of just how true for him those words had been. "If you study only those versions of yourself that attained extraordinary achievement, then you may be disappointed in your own life. If you have no knowledge of those avatars who led ordinary and perfectly content lives, then you may not have a model for the life you must yourself lead."

"Couldn't you just help me access a handful of randomly selected biographies and let me pick a few?"

"Certainly. But please remember: it's not what the person finally achieved that matters; what matters is the aggregate of small ways that an individual of your type chooses or fails to choose a direction that fosters the potential for self-realization within him. You might very well learn more of what you need to know from an ordinary person whom circumstances did not allow, finally, to rise to the top, than from a famous or accomplished one whom circumstances did not challenge in any significant way."

"What about happiness?"

"There now," sighed the old man, this time with more gentleness, "you're doing it again. There has never been a person alive who was once and for all happy or unhappy. You live your life in the present moment, Master Chakrapranesh, which is like a bee in a garden or a stick upon the sea. Suppose you read about one of your selves and learn he was happy. That doesn't mean you will be. Suppose he was unhappy. That doesn't mean you will be either. There's a saying—'First there is a mountain, then there is no mountain, then there is a mountain again.'".

Actually, the old man had used the word sky, but Prashan recognized the proverb. He thought his father had made that one up.

"That never did make any sense to me."

"It makes sense only in the context of an experience of conversion or dramatic new knowledge. When you first learn that your phenotype is not unique, it shatters some illusions. For a while, a person tends to measure him or herself against the type, loses a sense of individuality. Eventually, though, you realize that the single most salient feature of every single one of your avatars is the condition of having to exist—just like you—as an individual. Then you begin to measure the type against yourself; you think of yourself as determining the limits of the type and you ask yourself what you can bring to it. Instead of thinking you're just a type, you begin to realize that the type lives only insofar as you give life to it." The old man paused and smiled gently. "Of course, this will make more sense when you are sixty. Oh my! Look at that! I haven't seen one of those in years."

The old man pointed to a small book icon in the near lower right corner of the cube of air that served as a

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stage for the virtual display.

"What is it?" Prashan asked, merely to be polite.

The old man huffed through his nostrils with pride in the domain of his expertise.

"The phenome system is very old. No one remembers when it was constructed and much of it is no longer understood, but it is more than a database. Each phenome is a key, a fingerprint that unlocks the resources of the system. When you entered your genetic makeup into the system, you not only accessed information about your phenotype; you also identified yourself to the system as the phenotype's owner. At one time, this would have served as a way of logging on to your own account on the system. Now people use the system primarily as a database, but on occasions—rare occasions—accessing the system triggers other functions of the system relevant to the phenotype."

"I don't understand."

"You have mail."

"From whom?"

The old man did a quick check.

"From yourself."

Prashan stared.

"Obviously, that's not possible."

The old man stared back.

"Obviously, it is. This file was placed here by someone who accessed the system using your phenotype sequence."

"Couldn't someone look that up? It's basically just a net address, right?"

"You don't understand. Someone accessed the system the same way you just did—by a full DNA sequencing."

"You think I put the file there?"

"Someone with your phenotype did. In a way, it's the same thing. But the file may have been there for millennia."

"Can you check?"

"I think, Master Chakrapranesh, that it is time for you to take possession of something that belongs to you alone. It is not for me to open a document sealed with a phenotype."

"Even if I give you permission?"

"There's some ambiguity about what we're talking about when we talk about 'you,' Master Chakrapranesh."

Then the old man left Prashan to himself.

The file was a letter from Prashan's father.

Dear Prasha,

If you are reading this letter, then you have made a successful voyage to Polity, found your way to the Hall of Records at the Great Library, and accessed your phenotype. And if you are reading it, then I am dead. Greetings, my beloved son. I pray that all is well with you in the new world and I trust that the life you make for yourself on Polity will be a good one. It is to that end that you must learn all you can about this person that you are, Prasha.

But you must also know about the situation on Earth. There is another reason that I wanted you away from here.

Shortly after you were born, I became aware of the existence of the Reticulum. Earth, as you now know, is not, as we all grew up believing, the source of the human race; nor is it sitting "in lone splendor aloft the night," lonely and remote from other "intelligent life" in the universe. To think we once wondered if we were alone in the cosmos! The story of how I learned about and came to believe the true state of affairs and all the many wonders it entails is worthy of a book in its own right. Much of my journal simply documents my difficult journey toward this belief and the many forms of my astonishment and joy. For you who now have taken up a life in the brave new world—no, brave new heaven of worlds!—the story would seem quite dull and anticlimactic.

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So let me stay with facts you are likely still not to know.

Since you are now in the Hall of Records, you have seen the East Portico of the Great Library. You have seen the Taffonetta Mosaics, and you know that there is one mosaic for each world in the Reticulum. When a world joins the Reticulum, it gets a mosaic. As you have by now figured out, I led the team of Earth representatives that negotiated this process with the Reticulum. As you have also by now learned, Earth is not among the human worlds represented in the Grand Stair tower.

Because of its age and stability, the Reticulum does not have much of a sense of emerging civilizations. It assumes things and cultures have always been as they are and will always be as they are. That's background fact number one. Background fact number two is this: There are, as you may or may not know, seventeen "human" species in the Reticulum. Prashan, if you haven't already, you must get over the notion that our species is human and the rest alien. That is the most egregious form of ethnocentrism. Every language in the Reticulum has a word for human, and every species in the Reticulum applies that word to itself. From a purely semantic point of view, the word human *is of no practical use whatever, with the exception of making yourself look ignorant and giving offense to others.*

The Reticulum has lived with this problem for such a long time that it has forgotten that its solution is a solution and not a natural law of the universe.

The Reticulum does not define humanity according to species. The Reticulum defines humanity according to behavior. You may think you know what I'm going to say next, but I'm sorry to disappoint you. It is not using language, creating works of art, or practicing the Golden Rule that they place a premium on. It is not the ability to remember the past or to contemplate the future. It has nothing to do with individual behavior whatsoever. The Reticulum defines humanity at the level of society and of global society at that. The Reticulum defines humanity on a planet-by-planet basis as a society that is unified under a single world government. What kind of government doesn't matter. A military dictatorship, a state religion, white supremacy, democracy—each will serve equally well. The Reticulum is somewhat Confucian (or Machiavellian) in its belief that hierarchy of almost any kind is better than chaos.

As you can see, the Earth does not qualify as a human world by Reticulum standards by even the greatest stretch of the imagination. This would no doubt have been disappointing, but we might have continued as before and been no less happy as a race. But once our planet had come up before the Reticulum for classification, our fate had changed forever.

Imagine that a party of explorers comes upon an uncharted island near major shipping lanes of several powerful nations. On this island are plenty of cows, chickens, and monkeys, but no creatures recognizable as people. What do you call such an island? Uninhabited. And that is what the Earth scored on the Reticulum humanity test.

The best I could do was to make a case for us being on the verge of unified world government. The representatives knew, I am sure, how farfetched this claim was. But when a request for time to qualify is made, approval is almost automatic. The Reticulum doesn't want to make a mistake. I bought us five years. In that time, if the Earth does not become unified under a single govern-

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ment, then it will be up for grabs for whoever wants to claim it for whatever purpose imaginable. In the meantime, Earth is a protectorate of the Handful of Dust Empery. Look at the mosaic for this planetary consortium and you will see the Earth in the background.

Prashan, the Earth will not achieve political unity in five years. There are only two choices before it: occupation and annexation. Left to its own devices, Earth will be declared uninhabited. At that point no one will even bother further to keep us informed of what is going to happen next. No amount of force will be considered inappropriate to control or even remove the population. No use or misuse of the native fauna will provoke an outcry of injustice. The only alternative was to cut a deal, and cut a deal I did. The Handful of Dust Empery has already begun the process of annexation. Earth will become a part of that complex. It will be a human world because the Empery is a human empire.

Let me be clear. The people of Earth will never be citizens of the Empery. But I have seen how the Empery treats its "human animal" population. The best analogy I can think of is a rigid class system like that of nineteenth-century England: little upward mobility but general good treatment. Some young men will be siphoned off to fight in wars; some young women to serve in brothels or seraglia. That happens in our world already, Prasha! For others, there will be virtually no change in life. And for still others, there will be opportunities for service, promotion, responsibility, positions of trust and authority in a civilization far greater than anything Earth has ever dreamed of.

Like everything else in this universe, it's a trade-off, Prasha. Once the people of Earth are integrated into the Handful of Dust Empery, it will lose the potential one day to become a politically unified, and therefore human, world.

Am I sure that political unification of the entire planet is an impossible dream? Given the temperament of the world powers that be, the answer is yes. It would take nothing less than a global war of conquest to bring that about in the time allotted. Even if such a thing were desirable, one cannot simply start a war these days. We've spent too many years making that difficult, if not impossible.

Ironically, all it would take to make it happen would be to tell the people of Earth what their true situation is. The problem is not telling them; the problem is getting them to believe it. As I've said to you many times, magic could be all around us and no one would see it: we'd rather believe ourselves insane and trust reality to go its own way in peace than to admit to the occurrence of something truly out of the ordinary.

Still, I wouldn't be telling you this if I didn't know you to be out of any danger of revealing the secret. It is not permitted. If the Reticulum cannot achieve unification through an appeal to governments, they do not throw the question into the far more chaotic court of the people. Revealing the truth would submit you to the harshest possible retribution of the Reticulum authorities and the personal vengeance of the Handful of Dust Empery. Fortunately, nothing you say or do on Polity will matter in the least.

And—indeed!—who would want the secret to be revealed? That would almost certainly lead to war, to the worst and most widespread war of all time. Some would want to join the Reticulum. They'd vie to see who gets to do the unifying. Others would rather die than join, fearing to lose an imaginary independence. And of course any resistance to the Reticu-

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lum's terms themselves would bring about swift and violent countermeasures. What a mess, Prashan! Would it be worth it for half the population of the Earth to perish so that the other half could take its place in the civilized cosmos? Perhaps, if the people themselves could choose that path, but only perhaps. Who would dare to answer that question with conviction?

I do not believe that such a war is a fair price for the status of humanity in this brave new cosmos, Prashan. You may not agree. That is your prerogative. But please understand why I have made the choice I have. And, if you can, forgive me. I had no choice but to choose for the entire planet. I maintain that anyone who had the power to do so would do so. To whom else would you leave the decision? That is the dilemma that caused the Reticulum's policy in the first place.

Forgive me also for the selfish love of my only son that made me determined to put you out of harm's way. I've given you the opportunity to be a full citizen of the Reticulum, Prashan. This is a privilege that you, in my mind, enjoy vicariously for all of planet Earth. I give you my love, my son, and I wish you well.

Prashan was not so much shocked by what the letter had to say about the Earth—he had guessed as much—as by what it implied about his father's attitude toward him. This was the bitterest disappointment of all—that his father had not believed his son capable of rendering aid or comfort in a crisis or even of sharing in its consequences, but simply wanted him out of the way.

Time was running out. He could feel sad later.

Prashan decided to ignore the books of abstract information and start with the animated histories. The number was daunting. At the beginning of each one, an unsettling display appeared. First a diachronic: a Prashan face from prebirth to the last possible stretch of decrepitude. The process took a full minute. As it unfolded, the face turned slowly from a full left profile to a full right profile. Then a synchronic: thirty or so evenly spaced stills of the same process projected simultaneously—an eerie Janus head gone mad, a lifetime captured in a single moment, the flowering and withering of a human face. The head appeared as an icon marker in the far upper left corner throughout each subsequent file. It was, as Prashan eventually figured out, the Politan equivalent of a fingerprint. Looking at it, Prashan felt himself losing the desire to continue. The whole story—the only one that mattered—was contained in that one visual image. Why had his father wanted him to give up everything to come to this horrible place, only to learn that after all he did not matter in the least in the grand scheme of things, that he was not even who he thought he was?

There was any number of ways to search the list. Prashan thought of beginning with the most famous and successful, but that was a hard parameter to define, and he remembered the old archivist's warning about looking only at the extraordinary avatars. Also, he was struck suddenly with a kind of dread. What if none of them had accomplished anything remarkable?

He decided to search the list alphabetically in order to generate a few random examples. After what seemed hours of reading, he felt something like existential vertigo. So many lives so different from his own—yet all Prashans! He thought to himself a moment before realizing the absurdity of the notion that any of them were Prashans. Was even he himself a Prashan? Prashan's thrill at discovering the richness and variety of his phenotype's histories had been rapidly tem-

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pered by the feeling that he himself had in some sense ceased to exist.

He was wasting time. He began skimming other biographies.

There were no words to describe either the wonder or the horror of it. Prashan read a detailed biography of a man, a teacher and writer on a planet called Berryseed, an ordinary man, except that he was genetically identical to Prashan. Even the most mundane details of his life were imbued with significance. And then again, afterward, Prashan felt that sinking, hopeless feeling. This person was not he. It was someone else's life, not his own.

What was he looking for exactly? Some clue, just one, that would tell him what he should do.

Prashan breathlessly skimmed five biographies and then stopped to think. He was looking for a pattern to emerge, for a thread of consistency, however thin, on which he could hang some sort of plan or weave some sort of connection to the strange predicament of which his father had told him.

Nothing.

He was running out of time.

Quickly, Prashan skimmed five more and then five more. And then he skimmed another five. Again, he stopped to ponder their meaning. The problem was that these men led such different lives: their circumstances were different; their talents seemed to be different; even their choices struck Prashan as very individual.

Was he looking in the wrong place for a pattern? Was it the content that would provide the consistency? Certainly Prashan had the impression that consulting the histories of their phenotypes would have been the last resort of these men. Each seemed most conscious of himself as a person with the freedom to choose, a person responsible for defining his own character based on circumstances and actions, not inner essence, a person like Prashan himself.

Prashan's frenetic search for meaning had begun to degenerate into a heady blur of indecision. His aching mind drifted helplessly back to one of the tour guides in the Great Library's east portico. *The Taffonetta mosaics present a striking visual representation of the light-pump network connecting Reticulum worlds. The network enables all interplanetary communication. Indeed, the network served as* the *inspiration as well as* the *medium for Taffonetta's creation.* The medium?

Prashan could imagine no way the mosaics could function as they did without being hooked directly into the light-network's control center itself. Indeed, what in the Reticulum was not? All the complicated apparatus was there, wherever there might be. Here, where the mosaics were fed light from many distant parts of the galaxy, the lightflow was likely all relatively simple plumbing. *Lesson number one,* his first instructor had growled at him. *If light can flow in one direction along an entanglement field, it can flow in the other. The three main things you need to remember in this job* are *lightflow, lightflow, and lightflow.*

Prashan had forgotten the dictum just once during his apprenticeship. He had redirected light from a research station in the far reaches of the galactic halo and destroyed a full square light-minute of gossamers.

Gossamers were extremely fragile. Enormous in two dimensions, they hardly spanned the breadth of a moderately complex polymer in the third. The gentle pressure of the light they gathered kept them fully bloomed and stabilized. The concentrated force of that same light regurgitating through the bottleneck of the pump effectively disintegrated them.

Prashan swore a mighty oath. One of the monks looked up at him,

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frowned, and looked away again.

Prashan left the carrel. He still had some odd minutes before middlenight, and he surmised that the kind old Thurkmhen archivist—now sleeping noisily at his desk—would let him remain until whoever had the carrel reserved for the next day showed up. But Prashan doubted he would return.

He made his way down now darkened hallways and spiral stairs to the Great Library's east portico. It too now reposed in darkness, but darkness that made the gleaming swirls of landmass, ocean, and ice of the Taffonetta world-mosaics blaze with light that was mirrored dimly in the polished marble walls. The entire staircase glowed and thrummed quietly like the Reticulum itself, a vast machinery of pulsing life and commerce. In the faint light that filled the portico Prashan could just make out dark access panels in the walls below the stairs. Up close the panels appeared old and long unused. They gave more easily than he would have dreamed.

After another hour, Prashan found what he was looking for.

It was not true that there was one poem that had been written by any number of people. There was only this person writing a poem and that person writing a poem. The "poem itself" was an abstraction. And it was just the same with phenotypes. The only thing that gave the phenotype any meaning whatsoever was that human beings had worn it, lived it, laid it down on the altar of hope, ambition, or love. Prashan defined the meaning of his phenotype as surely as he lived: every choice did not matter less; it mattered more. Perhaps that was what it meant to be human—to be faced with the awesome responsibility of creating at every moment the truth of what one was. Choice mattered. Chance and circumstance mattered also. They were the grist of choice, the sea upon which the little bark of the self bounced, drifted, foundered, and followed its star.

It was the same with the quality of being human, no matter what the Reticulum said. It was not whether or not people achieved a global political identity. It was about whether a people faced the responsibility of creating at every moment the truth of what they were. Earth had been denied that responsibility, that choice. Or rather, individuals had been denied that responsibility in the name of their collective good. Ironically, they were protected from the consequences of their failure to achieve political unity in the name of their collective good. What was the collective identity of the Earth? The Earth did not suffer. People suffered. The Earth did not evince humanity; people did—if they were allowed to.

Prashan's choices were unlike those of any other of his many avatars—not necessarily in the particulars, but by virtue of being his here now. And yet in the particulars also. Prashan knew that by a single act he might restore to the people of Earth their choice to be or fail to be a human world; he had only to tell them that they had a choice. And he knew that the act in question might lie within his power. Prashan could prove to the people of Earth that the Reticulum existed. Or rather he could give them a sign. It would then be up to them to interpret it. But he would have to return to the Earth in order to give them his testimony. Prashan sighed mightily. He had never wanted to be a prophet.

Gayatri had not had a reason to go on-line for many weeks. The thought of reading and answering her e-mail, which now filled several screens in her inbox, filled her with despair. But life goes on, and she had to do something with hers. The small annuity Chakrapranesh had left her paid the better part of the bills, but she could

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not live on it indefinitely. There was also the matter of finding a reason to get up in the morning. So she had enrolled at the university, begun with a couple of graduate philosophy courses. She had always loved those discussions in the garden about Nietzsche and Husserl and had even been led to think she might have a talent for abstract thinking. Was that the flattery of a man who adored her almost as much as he did his son? Either because it was not or because her determination that it should not be so had carried her over the top, she was finding out that she could hold her own with the best minds her country had produced. Even the exchange students from Cambridge and the University of Chicago could no longer intimidate her in seminar.

Now the need to do the assigned research had forced her to revisit her Internet account. As she pondered the best word or phrase to key next into the search engine—the most logical ones having turned up nothing useful—her fingers idly tapped in the word Prashan. She tapped the launch-search key and immediately berated herself for wasting time. She was about to hit the back button when her screen went dark. Gradually a swirl of luminous specks emerged from the darkness and formed a slowly revolving pinwheel. Why was she getting a screensaver? Had she been woolgathering that long? And why this screensaver, one she didn't recognize?

A message box appeared in the middle of the screen.

Ah, there you are.

Prashan could not know for sure what would happen when he redirected lightflow from Polity to Earth. A surge of photons might flow into the gossamer positioned a few light seconds from the planet itself. The results might be spectacular. Possibly electromagnetic transmissions from countless Reticulum communications channels would bombard the planet, if only for a few microseconds. Almost immediately lightflow would cease for a few microseconds more as the system shut down and reconfigured itself to correct the deviation from the master schematic. During those few moments, the gossamer veil might cease to function and a barrage of EM waves beggaring the one before—this time from the galactic center—be unleashed. What would happen, when it would happen, and—more importantly—what Earth would make of it were things Prashan could only guess at.

Gayatri stared as another message box appeared below the first one, this one blank with a blinking cursor in the top left corner. She tried everything she knew to get back to the search engine, but the screen stubbornly remained. Just as she was about to hit the reset button, another word appeared in the first box.

Gayatri?

Her head was spinning. It was some spam advertising trick.

Are you there?

Her rage was sudden and swift.

Who the hell are you? Get off my computer!

This was absurd. She was talking to spam. She looked frantically for the off button.

Would you relax? It's me, Atch.

Atch who?

Gesundheit!

Prasha?

Sine quo non, *to coin a phrase*: Without whom not.

I know what it means, thank you! But I thought you—sorry, I needed a moment to question my sanity—I thought you—never mind! You didn't go abroad, then. Where are you?

I did go abroad. I'm in a galaxy long, long ago and far, far away. Well, technically I'm in the same galaxy, but you'd never know it to go

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for a walk in the park on Sunday afternoon.

Prasha, is it really you?

Who else do you know who makes such bad puns?

I can't believe it. We all thought you were dead. Or as good as.

I was as good as dead; now I'm as good as alive.

Where are you really?

About two thirds of the way to the center of the galaxy and forty-five or so degrees around it in the galactic plane. As the crow flies, that would be about fifty-five thousand light years. You definitely want to bring your toothbrush.

Her hackles once more.

Who are you really? How could anyone communicate across a distance like that at all, let alone with no time lag? Shouldn't there be a fifty-five-thousand-year—at least—delay? You're a fraud.

Let's keep the father of psychoanalysis out of this. The message impulses don't really have to travel all that distance. They have something called light-pump technology that works through the quantum synchronization of fields that are separated physically but stay in tandem, well, quantumtatively.

Bull shit!

It's not bull shit, and I'm surprised at your language. Who have you been hanging out with lately?

It is *you.*

Yes. Whoever you *is. I'm not feeling myself these days. Could I ask a favor of you? First, tell me what time it is there.*

About four in the morning.

Is the sky clear?

Yes. Why?

Can you see the Milky Way?

I don't know.

Well, go look out the window, dimwit!

It's definitely you, Prasha.

Go!

She went.

Yes, I can see the bloody Milky Way!

Good. Now, I want you to go outside. Will you do that?

What for?

Just do it, Gaya!

You know, it would be easier to take you seriously if you didn't claim to be on another planet halfway across the galaxy.

But you knew something of what my father did, no?

She paused.

Yes. I knew.

And you never told me.

I assumed he told you.

Now it's my turn to mention farm-animal waste products.

You know, he raised you for that—to be where you are. Your education put a distance between you and Earth. It made those of us who were close to you reluctant to interfere. We were afraid of revealing something that he didn't want you to know.

Yes. I've learned quite a bit about Earth since I left it. So much that I've decided to come back.

After he devoted his life—and ultimately gave his life—

What?

You didn't know? He refused treatment because it would have cost too much. You would not have been able to travel to Polity. He did it so that you could have a life beyond this poor ignorant ball of dirt!

For a long time, there was no message from Prashan, and Gayatri thought he had gone away.

So you knew that Earth knows nothing of the Reticulum.

She laughed.

Oh Prasha! Dear boy. Of course I knew. That's what I'm talking about. If you had had even the most casual exposure to normal Earth culture, you'd know what every other person on the planet knows—that there is no life beyond the Earth. That you

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could grow up thinking otherwise—and not realize your difference from everyone else in this regard—that is the amazing thing. Now you want to throw it all away. Why? Not for my sake, I hope.

Stop it, Gayatri. No more of that. You may not care deeply about me, but I know you don't feel coldly toward me. You're not capable of that degree of insincerity. You don't need to protect me from my own desires anymore. I'm coming back—whether you pretend to dislike it or not.

Whatever for? You've been given a great gift. I can't imagine a greater one.

That is the reason I'm coming back. Will you help me?

There was no answer.

Gayatri?

There was still no answer.

Dr. James Ingram woke to a jangling telephone and 4:01 staring at him in orange digits, like the eyes of some demonic winking bird of prey.

"What is it?"

"Dr. Ingram? It's me. Ted. I'm sorry to bother you."

His graduate freaking student. Working the graveyard shift at the Keck.

"Jesus Horatio Christ, Mullens. You'd better have a good reason for calling me."

"I think I do. Yes, I would say I definitely do."

Ingram waited as long as he could stand to—approximately three seconds.

"Well, what the hell is it, man?"

"We just recorded something unusual in the visible spectrum. I think you might want to take a look at it."

"What do you mean, 'something unusual'? What could be so unusual that it couldn't wait until the goddamn sun comes up?"

"Dr. Ingram? Have I ever called you in the middle of the night before?"

"What's your point, Mr. Mullens?"

"I think you'd better come have a look, sir."

Ingram's hands felt suddenly warm and damp.

"Is it some SETI thing?"

"I think you'd better come have a look, sir."

Ingram put the phone down. He no longer felt the least bit sleepy.

Gayatri stood under the stars, her loosely woven shawl wrapped around her shoulders against the moist night air in the meadow behind her flat. The frogs that had ceased their croaking and chirping when she had entered their midst began one at a time to sing their ancient songs again. Her arms, folded tightly under the soft cashmere, were stippled with hard goosebumps. There were flowers hidden in the darkness whose various fragrances evoked images and feelings long forgotten.

She looked up at the vault of the sky, like a fine dusting of flour on black silk, thicker along the galactic plane—the Milky Way, and sighed heavily. It was quite pleasant, really. She should get outside more often.

It was over before she had fully registered that it had happened at all.

The old manservant who had stood by Prashan's father at his death puttered in the west garden of the Chakrapranesh estate. He worked by starlight. It was a few minutes before 4:00 A.M. There were flowers that came out only at night and the old man liked to work when he could see them and see them as they were meant to be seen. There was a new owner, now, and that was another reason the old man preferred to work at odd hours. There were younger servants as well to perform most of his former duties. He was well cared for, but largely ignored. He had become himself a flower that opened only at night.

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It was getting harder and harder to see in the dark. The old man bent to study a Night-blooming Cereus blossom, ghostly white in the faint light of the stars. The smell was strong and heady and not entirely pleasant, but the strength of its character gave him satisfaction. He thought of the man, his master, whose character matched that of the reclusive flower and who was no more, and of the man's son, whose character had held such promise and who no longer walked under these same heavens.

The old man straightened his back, hurting from the strain.

He himself was not far from death, he knew, from blindness that no amount of squinting would penetrate, from the fading of vision of his mind's eye as well. We're all as isolated as the Earth is from the stars, he thought, going our separate lonely ways into oblivion. The old man thought of those he had loved and lost and bent his silvery head. It seemed as good a time as any to grieve.

Suddenly, the blossom seemed to brighten, as if lightning had flickered overhead. The old man lifted his head and stared in amazement. At first he thought lightning had indeed flashed and frozen in place in a sky as clear as black ice. But then he realized that what he was seeing was much higher than any storm, higher than the atmosphere, higher even than the system of planets that circled indifferently around the sun where height, up, and down had no meaning. From many stars in the heavens overhead—not all, but many—stretched thin bands of light, like threads of steel, to other stars, from star to star, and the whole thing disappearing like a river into the center of the milky way.

The show had ended, but Gayatri was still looking at the sky, still thinking how beautiful it seemed, despite the weird refractions caused by the tears in her eyes. In a little while, she knew, she would need to go inside, to sit down at her computer and answer the question that hung suspended there between two worlds so far apart. But for now she was content to look at the ordinary stars. She wanted to remember them forever just as they were. ▣

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The Man in the Mirror

Geoffrey A. Landis

Some of you may think you recognize this problem, but there's an important difference!

It was pure luck that Lynn Rockross was there. Pure bad luck.

Or maybe not luck at all. Out in the dark, you made your own luck. If the luck of Lynn Rockross was bad, it was luck he'd forged for himself.

Ramblin' Wreck had come out from the inner solar system on a long, constant-thrust interplanetary trajectory. After eight months in space, on their slow approach to Sedna the crew had nearly missed seeing the anomalous landform. It was a perfect circle of pure black. *Ramblin' Wreck*'s crew wasn't being paid to look for unusual things, and really, a twenty-two-kilometer circle wasn't even that unusual. Across the solar system, circles pockmarked the surface of every body, large or small, circles and networks of circles and chains and doodles of circles, craters of every size.

But this one was not just a circle, it was a perfect circle. And on a distant iceball, a world covered everywhere with a thick layer of reddish-brown snow, it was perfectly black.

Who would have expected an alien artifact on Sedna?

Sedna was one of the largest of the objects in the trans-Neptunian belt, a small world nearly the size of Pluto, but in a wildly eccentric orbit, so far away from the Sun as to be forever frozen.

It was the topic of discussion on the *Ramblin Wreck* for about a week as they braked into orbit, between poker games, but the crew chief, Kellerman—a hard-nosed miner with the soul of an accountant—told them that investigating alien enigmas was not the job that the crew of the *Ramblin' Wreck* had come all this way to do, and he was not about to take good time away from the paying job to go look at it. They were miners, not scientists. Sedna was a rich source of organics. Organics could be shipped to any of the colony worlds in the inner solar system. If they could find ammonia as well, they'd have pay dirt. Ammonia was a source of nitrogen, valu-

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able nitrogen, far more valuable than gold or platinum in the built worlds where every volatile molecule had to be imported. Prospecting Sedna was an economic gamble; it was so far from the Sun that only a huge strike would make it worth paying the amazing shipping costs to send resources inward. But the built worlds were an ever-expanding market, and if they could show that Sedna had deposits rich enough to justify the travel time, Sedna would be a little money mine for the corporation, a slow but steady source of income.

Braking into elliptical orbit around Sedna, they photographed the strange circular anomaly as they scouted for resources, and they sent back to the inner system all the data they happened to gather on its location and approximate size. In return, they were ordered to stay away from it. It was not a natural artifact, they were told, and it most certainly wasn't something humans had built, since they were the first people ever to reach Sedna. It was alien. They weren't qualified to investigate. Back in the inner system somebody worried that a bunch of union-slacker rock jockeys scratching around an artifact of incalculable value would be far more likely to destroy something than they would be to find something valuable.

From their orbital reconnaissance, they had mapped a rich ammonia deposit, a frozen lake of ammonia larger than most asteroids. That, along with the organic tholins frozen into the ice, looked like a good place to start operations.

The mining ship landed on Sedna more than five hundred kilometers around the planet from the artifact, at the ammonia site. Somebody else would be out to investigate the artifact, some slow and careful scientific team, with all the tools and backup from Earth needed. *Ramblin Wreck* was there to mine.

"That's crazy," said Rockross. "All this way, and we stop a lousy five hundred kilometers from the one tourist attraction on the planet?"

His buddy, Dinky Zimmer, gave him a quizzical look. "We're here to do some mining," he said. "Who cares about a black circle if it doesn't have ammonia?"

Adrian Penn, the third on his three-man crew, said, "If we hit pay ice, with the bonus we're due, we can see all the tourist attractions we want. You want to check my seals?"

Rockross checked Dinky's suit seals, and then Adrian's, and gave them both a thumbs-up; and then Dinky checked his. The suits were the close-fitting style that the crew called nudie-suits; everybody checked their own seals, of course, but then for safety they each checked each other as well. The checklist required that every step be verified with a buddy. After seal checks, he verified his suit battery charge, and then checked Dinky and Adrian's charges while they verified his charge. They were suiting up for their first eight-hour shift, taking ice cores and setting up the thermal radiators that would be needed for mining. Someday—if the nitrogen strike was good enough—the equipment they were setting up would be the head of an interplanetary pipeline, where induction motors would toss two-tonne bricks of frozen ices into trajectories that would, over the course of years, coast downhill to markets in the inner solar system. That would be all automated, of course. But for now, humans were needed to scout and set up equipment.

But Lynn Rockross—known as "Lee" to both friends and rivals—wasn't thinking about his work, although he was paying enough attention to avoid making errors. He wasn't done with the artifact. He had other ideas.

Lee was a shift leader on the *Ramblin' Wreck*'s mining operation, responsible for a crew of three. He was qualified on every piece of equipment used in low-gravity and low-temperature extraterrestrial mining operations. He'd been mining and prospecting ever since leaving his home in the domed cities of

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Vesta, something he had done at fifteen, the age of emancipation in the middle belt. He'd gone first to the ice moon Callisto, and after a little time in a low-paying job on a melt line, had joined the crew on a mining ship. In five years he had worked on four different mining and prospecting ships, earning his union card, working his way up from unskilled labor to shift leader. When he could, he liked to spend his time with wildcat surveys, where he would be dropped off on a likely body with nothing but an augmented suit, a laser drill, and a mass spectrometer. For weeks at a time, he'd be alone to characterize mineral composition in the hopes of a finding a rare strike of usable material. Lee was perfectly comfortable alone in a suit, out of contact with the rest of the universe.

Lee was smart enough in his own way, but he knew that shift leader was as high as he could climb with only his self-education, learning about whatever subject caught his attention. For the long voyage out to Sedna, he had signed up to take university classes, the first step up toward supervisor and eventually running his own ship. Now his personal databot had a load of material for him to study in his spare time: literature, structural mechanics, and physics, to start. Studying should have accounted for his off-shift hours—he had a lot to catch up on—but with the discovery of the strange black circle on Sedna, he was thinking of changing his plans.

The radioed instructions from back in system, he knew, were more properly a suggestion, not an order. The crew of *Ramblin' Wreck* wasn't subject to orders from scientific institutions a few billion kilometers away.

The union mandated that, even mining high-grade ammonia, they had to be paid triple overtime at hazardous-duty rates for shifts longer than eight hours, and the flint-eyed wretch Kellerman wasn't about to pay overtime. Lee and his crew got sixteen hours off for every eight working, and the union steward watched damn carefully to see that they weren't given unofficial duties in their off time. So he had the time.

They finished their shift, bringing back the ice cores for the cryomineralogy lab to analyze, and Dinky and Adrian headed off to unsuit and hit the showers. Lee watched them head in, but didn't follow.

Lee figured he could skip one day of studying and bypass the after-shift perpetual floating poker game. There was something interesting out there, and he would be damned if he wasn't going to go take a look. Although this was a mining operation, not prospecting, Lee was fully certified for solo prospecting and didn't have to tell anybody what he did in his off-shift hours, if he didn't want to. And so he slipped away, without telling anybody.

The artifact was half a world away, far from the *Ramblin' Wreck*'s position near the ammonia deposits. He topped off his suit batteries and then checked a snowcat out of the equipment depot. It was technically theft, maybe, if you looked at it one way, since he wasn't actually on shift, but it wasn't as if he wasn't going to return it—where could he possibly go? He wasn't even using up fuel, since the snowcat had a little nuclear generator that gave out a constant 14.3 kilowatts of power whether it was being driven or not.

That had been his first mistake, going out alone. A few hours later, it was beginning to look like it may have been a fatal one.

The drive was a thrill; a little under three hours at an average speed of almost two hundred kilometers per hour. In the low gravity, the sled bounced up on every little hummock of snow. The first hour he had steered carefully to the smoothest paths, and the bumps had scared him nearly out of his wits. But the sled had attitude control thrusters that kept it from spilling over when it was airborne (or, technically, vacuum-

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borne, he supposed, since the microbar pressure of mostly-helium surrounding Sedna was nothing that could vaguely be given the nomenclature of air.) After a while he realized the snow pack was so thick, it had smoothed out the planet's hills into natural ski jumps, and he had gotten more and more adventurous. Now he was picking jumps that gave him a hang time of five seconds, ten, thirty.

A hell of a lot more fun than studying, he thought.

Viewed through his intensity-enhanced goggles, the landscape was low rolling hummocks of a deep, dusky red, the color of Georgia mud. Sedna was beautiful. Lee saw a landscape of soft hills lit by urgently brilliant stars, speckled in colors: the glistening white of water-ice snow splashed across through scars in the surface of red tholins. He tried switching the image intensifier off. At first all he could see was darkness, and the sense of speeding across darkness, trusting in the autopilot to avoid obstacles, made his heart hammer. After a minute he began to make out the smudges in the darkness, and in a few minutes more, even though the sun was billions of miles away, he discovered that he could still see. Without the image intensifier, the surface was colorless, a pale ghostly glistening in the starlight, with the Sun so small he could have covered it with the head of a pin.

It seemed more real to him this way, so he left the image intensifier off. The heads-up display told him the topography, and the autopilot picked out the smoothest path across the snow.

"You guys should have come with me," he said, speaking to the empty air. "Poker's no fun, not until after payday, anyway."

He was lucky he didn't sled right into the artifact. He'd been having such a good time hot-dogging the snowcat, he'd stopped paying attention and had lost track of how far he'd come. Fortunately his navigation computer hadn't, and warned him when he was approaching the artifact.

Once cued to look, he could see it: in the distance, the horizon cut off abruptly. Lee flicked the image intensifier back on, and suddenly it was impossible to miss, a sharp black line across the red horizon. He slowed down to approach it cautiously, edging up to the razor-sharp edge between the snow and the black, and finally getting off the snowcat and creeping forward slowly.

He looked down.

The black was speckled with stars.

For an instant he thought it was a hole straight through the planet, and then he wondered if it could be a portal to another universe.

Lee anchored the snowcat and clipped a safety tether to it. His toolpack carried all his gear, but carrying the pack made it too awkward for him to bend over, so he took it off and wore only the skin-tight nudie suit. Making sure that his tether was secure, he kneeled down at the edge and leaned over to look down.

He saw a golden helmet faceplate—his own faceplate—looking up at him.

The black surface was not black at all, but a gargantuan mirror reflecting the blackness of space, angled steeply away from him. Close up, he could see the sharp image of stars reflected in it. He was so close to it that it seemed perfectly flat, but looking across in the distance he could see the subtle curve.

He put his hand on it (the mirror-image hand coming up from below to touch his), and it was perfectly smooth and perfectly slick. Absolutely smooth, slicker than oil, as if he was touching nothing, no resistance at all to him sliding his palm across the surface.

Through his glove he couldn't sense the temperature. His suit was a near-perfect insulator; it had to be, of course, to operate in the outer solar system, where the miners walked the cryogenic ice fields of trans-Neptunian and Kuiper objects.

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Lee checked the external temperature meter on the fingertip of one glove. Pressing his finger to the mirror's surface, the gauge read five Kelvin. The reading was so unlikely that he pulled his hand away to try another spot. The next spot was still five Kelvin, as was a third spot, and a fourth.

"Sonnabitch," he said. "Colder than a loan shark's heart."

His meter wasn't broken; he checked a patch of the crusty snow surrounding the pit, and got the right number, thirty Kelvin. The surface of Sedna was colder than the caves of hell, but the temperature of the black surface was twenty-five degrees cooler yet, far lower than it had any right to be.

Slowly, he worked it out. The surface was not black; it was reflective, and only appeared black in that it was reflecting the starry sky. It must be very close to a perfect mirror indeed. Far as they were from the Sun, the snows of Sedna still absorbed sunlight, and that heated them a few degrees above absolute. But this perfect reflector must absorb no light at all and stay cold. Somewhere in the far infrared, it must radiate away a tiny amount of heat, he realized, but in all the wavelengths in which the Sun shone, it absorbed nothing, and so was colder than the surface it sat on.

It was an enormous concave mirror. A giant telescope, miles in diameter—built for what purpose?

Lee stared out across it, marveling. It showed no signs of age, but certainly it must be ancient. Who had made it, and when? Sedna was one of the more eccentric objects in the solar system's Kuiper belt, a dwarf world in a long slow orbit that took it to a farthest point nearly a thousand astronomical units from the Sun, barely bound to the Sun at all. Probably it had once been an interstellar wanderer, captured by the Sun millions or even billions of years ago from the cold darkness between the stars. Where had it come from? What unknown race had built such a gargantuan telescope mirror, and for what purpose?

He leaned over to put his faceplate right against the mirror surface, steadying himself with one hand carefully wrapped around the taut safety line. The surface was perfectly smooth, perfectly reflective.

And suddenly the line was slack.

He stood up and saw the snowcat looming toward him in the darkness. He had anchored the cat against a hummock of ice, but waste heat from the reactor had melted it free, and it lurched downhill now, staggering drunkenly toward him. Without thinking, he took a step back away from it.

He realized his error instantly. His cleated boots found no purchase, the surface of the mirror slicker than ice, and his feet shot out from under him. He reached out wildly as he fell. In the low gravity, everything happened in slow motion. With one hand, he grabbed onto the toolpack he had set down on the edge. For a moment he hovered there, on his belly, his feet dangling down the slope of the enormous mirror, hanging on with his left hand clutching the toolpack on the edge of the slope, the right still clenched tightly on the now-slack safety line.

The snowcat slid forward, bounced against a ripple in the ice, toppled over onto its side, and ground its way to a halt with a silent spray of crimson snow.

It rocked a little and then settled into place.

It seemed stable. Very slowly, trying not to move, he gathered up the slack in the safety cable and gave it a very careful tug. The snowcat stayed firmly in place. Working one-handed, he fixed the cable onto his belt clip.

Gravity on Sedna was minuscule, less than a twentieth of a standard Earth gee, and it would be easy enough for him to pull himself out of the pit, even one-handed. He relaxed for a moment, the danger temporarily at bay. His left arm was getting stiff from the awkward posi-

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tion holding onto the toolpack on the rim, and he shifted it minutely.

The pack that anchored him broke loose from the snow.

In gloriously slow motion, the toolpack, and Lee, slid down onto the mirror. He flailed for the lip of the pit, seeking anything he could grab onto, but ended up with only a handful of snow. In the process he released the toolpack, and it slid away down the slope, spinning slightly and gathering speed as it slid.

The safety line was still clipped to his belt, the other end attached to the snowcat. He slid down into the mirror, and when the slack in the safety line had played out, it caught with a jerk, stretching slightly, but held. Above him, at the other end of the rope, the snowcat shuddered slightly, but didn't move, stuck in the ice. He was swinging at the end of the line. He stretched out his arm, but the rim was just out of the reach of his outstretched fingertips. With one hand, he reached out and grabbed the rope to pull himself up.

And the clip broke.

The line whipped away from him, sliding through his fingers as if it had been greased, and with a slow, easy grace, Lee Rockross slid down the frictionless surface of the mirror.

As he slid, he tried to scramble up the side of the slope. The rim of the dish was only inches away, but despite his frantic flailing he could get no purchase at all, and he coasted smoothly down, gathering speed at a slow but inexorable pace. It was maddeningly frustrating.

I screwed up, he thought.

Sliding down the mirror, he had time to contemplate his life, and the ports he had visited, and his sins, both the ones he had accomplished, and the ones he hadn't gotten around to yet. All of them seemed petty and meaningless.

All that took him about twenty seconds, as he slid, face down, still scrambling against the surface with a futile, reflexive motion.

After a while he gave up. He twisted around and with some amount of effort managed to sit up. Moving on the frictionless surface was like moving in freefall, and he'd had plenty of experience with that. By working on it for a while he managed to get the hang of it. He windmilled around until he was facing almost in his direction of motion, took stock of his situation, and tried his best to calm himself down. The emergency protocols had been drilled into him, and he chanted them silently like a mantra.

Protocol for an emergency: First, take whatever immediate actions are needed to prevent the situation from deteriorating, and compartmentalize the damage.

Well, that was simple. He was sliding down toward the bottom of a mirrored pit, and there was nothing for him to grab onto. There wasn't any way the situation could get much worse.

Second, activate dual-band emergency locator beacon on broadcast channels 121.5 MHz and 406 MHz.

The snowcat, already out of sight above him, had his emergency beacon, along with the rest of the long-range com gear. The spare emergency beacon was in his toolpack, sliding along the mirror somewhere ahead of him in the dark

His suit had a low-power ultrawideband link for voice. It was meant for miner-to-miner conversations, but it had been deliberately designed for near-field transmission only; a hundred miners would pollute the radio spectrum otherwise. He recorded a brief call for help, and set the suit-to-suit link to squawk it out in five-second bursts twice a minute. That was a useless task, but at least something he could do to calm himself down. There was no chance it would be heard. *Ramblin' Wreck* was over the horizon, way out of radio range. Since nobody was supposed to be out on the surface, there was no com relay in orbit.

Emergency protocol, item three: Survey your situation; ascertain your loca-

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tion and velocity relative to possible sources of assistance.

There were no possible sources of assistance. Still, his suit did have an inertial navigation unit; he could check his location and velocity. He verified that it was on, and brought up his position and velocity in the heads-up display. The dim red figures glowed in his faceplate, floating above the darkness. He was sliding down a slope at an angle just under twenty degrees, currently moving at eighteen meters per second relative to the ground. As he watched, the inertial guidance unit updated his speed. Eighteen point three meters per second. Eighteen point six meters per second.

He had no sense of his speed. Except for the slowly incrementing number in his display, it felt like he was motionless.

That wasn't doing him any good. He had the computer display a plot of his position as a function of time. His path across the surface of mirror was in the form of a perfect paraboloid. That made sense. Of course the mirror would be a paraboloid; it must be the reflector of an enormous telescope. He extrapolated the parabola forward, and plotted his motion as a tiny moving dot. He was moving faster and faster every minute, but his acceleration was slowing down as he headed toward the bottom. Extrapolating from the shape of the curve, he would reach bottom in about four minutes, or just a little over six minutes from when he had slipped off the edge. And then his momentum would carry him up the other side of the slope.

Emergency protocol, item four: Check consumables. Take action to minimize use of critical supplies until help is effected.

Lee checked the status of his suit. He didn't have consumables in any real sense of the word. His oxygen supply was a zero-buffer in-line rebreather; every breath he exhaled was stripped of carbon dioxide, which went through an electrolysis cycle that broke it down and immediately recycled it to his next breath. The whole thing was run from a solid-state battery, the same battery that also powered his suit heaters. So it was the batteries that were his ultimate consumable. He checked his battery status: green, at 76 percent full charge. The batteries were sized to run for two full mining shifts plus a little margin, so that gave him a bit over twelve hours of remaining power for life support. Was there any chance somebody would deduce where he was and assemble a rescue before he ran out of power? Unlikely. Nobody would even notice that he was missing until the start of his next shift, which was—he checked the time—another thirteen hours. And even then, it would wait until the end of the shift before somebody would check his quarters to find out why he'd missed work.

Item five: Appraise resources. Apply the resources available in the most efficient way to effect rescue.

Fine. His resources were his suit, and—and nothing else, really. Everything else he carried had been in the toolpack he'd lost, or was left with the snowcat. If he'd been wearing a suit for free-space operation, he would have no problem; the maneuvering thrusters would be enough to push him across the slope in any direction he wanted. But the surface suit he wore had no thrusters.

Item six: When the emergency is over, contact Spacewatch to cancel emergency call for assistance.

He figured he could ignore that part of the emergency protocol.

Running through the emergency protocols hadn't shown him any way out of this problem, but it had at least damped down his panic. He was now a minute away from the bottom, moving at a hundred and sixty meters a second. He converted that in his head. Vesta, where he had been raised, had been originally settled by Americans, and had stubbornly refused to switch to metric, even after America itself had joined the European

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Union. He was sliding along at just under a hundred miles an hour. He checked his display again, and noticed that his path wasn't actually taking him quite to the bottom. He would miss it slightly to the left. Right, he thought. He'd been swinging when the clip holding the tether had snapped, and the lateral velocity meant that his actual path was an ellipse—in fact, a Lissajous figure—that wouldn't quite pass through the center. The actual bottom of the mirror would be passing slightly to his right. He inched himself around to look, knowing that it was a pointless move, since there would be nothing to see.

But there was something to see, something gliding silently past. He couldn't quite make it out, until he realized his image intensifier was off, and turned it on.

He was racing past a landscape of dark sand and rocks and a few enormous boulders. It seemed to be just meters away from him, but a glance at his rangefinder told him that this was an illusion, and the rubble field was nearly fifty meters off. The bottom of the mirror was not empty, but was filled with a million years of debris that had fallen into the crater and slid to the bottom.

The suit thermostat was working fine, but he felt suddenly cold. Hitting that debris field at a hundred miles an hour would have been an abrupt end to all his problems.

The rubble slid past him—or rather, he slid past it—and dwindled behind him. He had reached the lowest point on his trajectory and was rising now, sliding up the slope toward the opposite rim.

He turned the image intensifier off again, to conserve the tiny amount of power it drew. He was now sliding feet first up the slope. He checked his data. At the lowest point of his slide, his maximum speed had not quite hit a hundred and seventy meters a second, and now he was decelerating as the slope steepened and he slid up toward the opposite rim. He leaned back to think, and caught a glimpse of the sky.

Even with no enhancement, the sky was spectacular. There were stars below him, and stars above him, and it seemed as if he were gliding on a perfectly transparent sheet of ice through endless space. The sun was a speck of fire, so bright that it almost hurt his dark-adapted eyes, and yet so small it shed nearly no light. When he averted his vision, he could see that it was surrounded by a ghostly disk, so faint as to be little more than the memory of a glow, the zodiacal light. And surrounding that were stars in their millions, fragments of diamond scattered across the velvet of night, glinting in colors from electric blue to a deep brick red.

Lee stared at the stars, running through the emergency procedure list again in his mind. Stop ongoing damage, squawk for help, check location, conserve consumables, survey resources and solve problem, call home.

Step five, that was the hard one: survey available resources and solve the problem. But he still had no resources to survey. His surface suit had no attachments, not even a spare tank of oxygen he might have been able to use as a cold-gas thruster. It protected him from the cold and vacuum, gave him something to breathe, and that was it. Life support and batteries were integral to the suit; he couldn't take them out even if he wanted to. And everything else was in the miner's toolkit.

Stop, squawk, site, safeguard, survey and solve, and finally call your mother to tell her you're safe.

Survey resources. What about the toolkit? It was sliding across the same surface that he was, with a head start of only a few seconds. It had the tools that might solve his problem—a radio beacon, for one. And, if nothing else, he could use it for reaction mass. If he could hurl it away from him fast enough, he would gain a little bit of momentum to get him to coast over the rim. It was

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on the mirror with him, maybe only a few meters away.

Lee twisted himself around until he was sitting upright and snapped his image intensifier on to full. Toolpacks were distinctly colored, to make sure one miner didn't accidentally grab the wrong one, and his was a bright lime green. It took him only a few seconds to spot it. There it was, no more than twenty meters ahead of him, spinning slightly as it slid.

In fact, since it was ahead of him, it would reach the far lip of the bowl before he did, turn around, and come right back to him.

According to the graph he had made in his display, the rim was about a minute away. He fixed his gaze on the toolpack sliding ahead of him, ready to grab it as it slid back toward him. Yes. There it was, right up at the edge—was it actually going to fly up over the edge and out of the bowl? It just kissed the edge, slid toward the left, and then started gliding back down toward him.

He was slowing down as he rose toward the edge, and the toolpack was speeding up as it fell. He stretched toward it, spread-eagled across the mirror, but the toolpack slid past well outside the reach of his outstretched fingers.

But he had no time to cry out over missed chances. In another moment the edge of the mirror approached, and he clambered across the mirror's surface on all fours, stroking like a swimmer. If he could just gain even a single meter of altitude . . .

To no effect. The edge hovered ahead of him, tantalizingly close, tantalizingly out of range. All his effort hadn't gotten him a millimeter closer.

The rim disappeared in the distance, as he gained speed back downward.

Why hadn't the pack come back to him? It was that elliptical motion, he realized. The toolpack was orbiting the center of the mirror, just as he was, sliding in an ellipse that didn't intersect his trajectory.

He was sliding back down now. Six more minutes to the bottom, twelve to the other side. And then another twelve minutes down again, and back, and back . . . until his battery died and he froze and suffocated. And after that, how long would his body continue oscillating? Days? Years? The mirror couldn't be perfectly frictionless; nothing in the universe was perfect. If it was perfect, the rubble wouldn't be there in the center; the rocks that fell in would still be oscillating.

He was the bob on a pendulum, he thought, with a frictionless surface instead of a rope. For a moment his thoughts took him back to his childhood, growing up on Vesta. He and his brother had competed with each other on the swings, seeing who could go higher. They must have tried a hundred times to swing so hard as to go all the way around, over the bar. They never succeeded, even with Vesta's low gravity making it easy; when they barely got higher than the pivot point, the rope would go slack, and the swing would fall with a jerk.

Thinking about the past wasn't going to help him, and he forced his thinking back to his present situation. In a few minutes he would be back to his starting point. What about the safety rope? If it was still dangling down—but it wouldn't be. He replayed his fall in his mind. The safety rope had snapped back like an elastic band when the clip broke, and disappeared over the edge. He would try to grab it, if it was in reach, but he wouldn't count on it.

It wasn't. He slid up, frustratingly close to the rim, and for a moment he seemed to hover with the rim just out of reach, and then slid away. The toolpack hadn't come any closer to him this time than it had on the opposite rim, and the rope was nowhere in sight.

But here was something else to think about. Sedna rotated once every ten hours. In—he checked the time—two hours, the sun would be overhead. In

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the cold dark a hundred astronomical units from Earth, the intensity of the Sun was dim, but what would happen when it was focused by a mirror twenty kilometers in diameter? In fact, that was very likely the purpose of the mirror, he realized. It wasn't a telescope; it was an enormous solar furnace.

But he wasn't thinking. The mirror might focus sunlight to a high concentration indeed, but that would be miles overhead, at the focal point of the mirror. On the surface of the mirror itself, the sunlight would be no brighter, and no less bright, than any other time. It was freezing he had to worry about, not frying.

Passing the bottom of the mirror. Lee clicked his image intensifier on again, watching the rubble in the center, trying to think of a way to make use of it. But it was still fifty meters away. Nothing useful there.

He clicked it off, and he was surrounded again by a world of stars and darkness.

Should he go back to reflecting on his life? Swinging with his brother, that was a good time, even if they never did make it over the bar. He could spend the remaining few hours remembering good times. The thing about being a prospector, he thought, is that you see a lot of places, but you only see the backsides, the seedy sides, the places in town near the dockyards. And they all look the same. He knew miners with a girl on each rock-town they visited, but no matter whether the deal was explicit or implicit, one way or another they were strictly pay propositions. He made good money, when he was employed, but somehow he never really managed to save any of it. It wasn't that he was wasting his life, not exactly, he thought, but there had been enough of it already. It was time for him to move on. He needed to study, finish a degree, make something of himself.

Well, he had plenty of time to study, if that was what he wanted to do. Not that it would do him much good—he was trapped in a bowl. But that reminded him, he did have one resource that he hadn't though of. His personal databot had a load of study materials, and one of his subjects was physics. What if his problem had a solution somewhere in the physics texts? It was a long shot, but why not try?

He booted up his study material, and put in search text: "PROBLEM, SLIDING ACROSS AN ENORMOUS MIRROR." He had no real hope that anything would come out, but the search gave him one hit.

Astonishingly, the hit was in literature; not physics. The link was to the twentieth century, an ancient science fiction story that had two men sliding on the surface of a frictionless mirror. He'd always hated classic science fiction. He'd read enough of it in school, before he'd dropped out. The teachers all seemed to love it. But the old authors had always gotten everything so wrong. The characters did amazingly dangerous things, with no safety backups; they were uniformly too stupid to live.

Things like stealing a snowcat to drive across an alien planet, without telling anybody where they were going? Well, it has seemed like a good idea at the time.

The databot didn't have the text of the story, only a brief summary in a survey on twentieth-century literature. He scanned through it. It wasn't quite his situation, he realized with mounting disappointment: the characters in the story had far more resources at their disposal. In the story, the two characters were roped together, and they used that fact to pump up rotational speed to allow them to fly apart. The discussion went on to say how the solution in the story wouldn't work; the author had ignored conservation of angular momentum. No help! Lee would have thrown the book away in disgust, if it had been a physical book and not just a glow in his heads-up display.

If only he had a book to throw away!

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Or anything at all. He could have used the momentum. It was exactly like being adrift in space without a pack. He had no control over his motion.

See related terms, the summary said. *Simple harmonic oscillator. Frictionless motion.*

He queried simple harmonic oscillator, saw that it seemed to be a tutorial about sines and cosines, with no obvious application to him, and then flicked over to frictionless motion and scanned the tutorial. Superfluid helium, it said, was the only substance known to support frictionless motion. Well, that was interesting. Could the aliens have found some way to solidify superfluid helium? No, that was ridiculous. But, still, the surface of the mirror was desperately cold, cold enough to make even God shiver. Maybe the mirror was made of some substance that had a thin film of superfluid helium on the surface? Could he possibly heat the mirror and destroy the effect?

But no, that was a dead end. Even if it weren't frictionless, the surface would still be far too smooth for him to be able to climb the slope to the rim. He'd have to carve steps into the slope, and he had no tools to do that. Did the material have any give at all? He kicked at it as hard as he could, but it was like kicking solid granite. His toe hurt, even through the boot, but there had been not the slightest give to the surface. Whatever material it was made of, it was hard.

A frictionless surface probably had commercial value, even if it only worked when it was cooled nearly to absolute zero. If that bastard Kellerman just knew that one of his workers was slipping along the surface of a material more valuable than any ammonia on the planetoid, rescue would be here soon enough.

That line of thought didn't bring him any closer to rescue.

The rim approached, or rather, he approached the rim. He slid toward it, slowed, hovered frustratingly short of the edge, and then dropped away. Lee checked that his radio was still broadcasting the useless call for help; verified that the toolpack was still out of reach, checked his battery status. No help, no help, no help.

He was sliding down the slope on his stomach, like riding a sled. He twisted around and then carefully pushed himself up onto his hands and knees. He pushed upright, balancing on his knees, with one hand on the slippery mirror for balance. Wobbly, but after a while he could keep his balance. That wasn't too hard. He tried getting up onto to his feet, and made it for a moment, his arms windmilling desperately to keep his balance before his feet shot out from under him.

It was like trying to stand on ice. He worked at it and eventually found his balance. It was a lot like snowboarding on the hills of Callisto, he realized, or skiing the polar caps of Mars, something he'd tried once on shore leave. The carbon dioxide snow of Mars was nearly frictionless, too, but if you stayed loose and alert, you could stay vertical. The trick was to keep his center of gravity above his feet. It was a matter of holding his arms out, keeping his knees bent, and making continuous sliding adjustments. The low gravity worked in his favor, giving him time to correct.

He stood, surfing down the slope. If only his brother could see him now!

It did nothing to help his situation, but just being able to stand gave him a tremendous feeling of accomplishment, as if he were now in control of his environment. He imagined himself an Olympic ski champion, gliding down the run of artificial snow on the slopes of Olympus Mons. He checked his display: almost to the bottom and heading uphill again, he was racing at 150 meters per second. That must certainly be breaking all ski records! He raised his hands in triumph to the imagined cheers of thousands—and skittered backward, landing on his butt.

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In a tenth gee, falling down was no big deal. Lee twisted around and tried again, and with practice found he could stand almost without conscious effort.

As if being able to stand up would do him any good.

Or would it? Wait, if he could stand, couldn't he jump? In a tenth gee, he ought to be able to jump pretty high. Wouldn't there be some way he could just jump that tiny distance from the top of his trajectory to the rim?

With a little practice, he discovered that indeed, he could push himself off the ice hard enough to get momentarily airborne. It took concentration and a lot of coordination to actually jump, instead of just having his limbs flail out in all directions across the ice. (Not ice, he thought. Mirror. It's not really ice.)

But as quickly as his elation rose in him at the sudden hope, it drained away. Being able to jump didn't do him any good, because he could only jump straight up. No, not even straight up—he had no traction at all, so he could only jump in a direction exactly perpendicular to the surface of the mirror. He called up the picture of his trajectory across the mirror in the heads-up display and stared at it, trying to see a flaw in his reasoning. Suppose he jumped right at the moment he reached his highest point. But the slope of the mirror was the wrong direction; he'd actually be jumping away from the rim. No help. If he jumped a little early? No, still no good; he'd always be jumping the wrong direction.

He drew himself a little diagram in the heads-up display and put an icon of a man in a spacesuit on it. Any way he studied it, though, he couldn't see a way that jumping was going to help him. In fact, it even hurt him—if he could add just a little bit to his velocity toward the rim, he could make it, but his jumping added velocity away from it.

Or, wait, was that right? His jumping would actually be perpendicular to the way he was moving. So it wouldn't change his velocity along the mirror. Or would it? He wished he understood the physics a little more. The mirror was curved. It sure looked like there ought to be a way to make this work. His jump was a vector, and there had to be some way to make that vector work in his favor. But he couldn't see it. It was too complicated for him

Appraise resources available and apply them to solving your problem. His resources were himself, the child on the world's biggest swing set . . . and a databot tutorial about physics.

He flicked back to the tutorial, searching through screen after screen explaining simple harmonic motion. That was his situation, he saw; sliding in a parabolic potential well. But nothing in the tutorial discussed pushing off in the third dimension. It explained that his motion followed a perfect sinusoidal curve—he knew that already—and that the period of oscillation was constant, a fact that didn't help him any. Then the tutorial went on to cover the case of driven oscillators, when there was an external force pushing in time with the oscillation. Even a very small force, if he could apply it in phase with his motion, would quickly increase the amplitude of his motion. Even a small force—he wanted to scream at it. That was the problem! He didn't have a small force, and the tutorial wasn't giving him any clues. Instead, it wanted to tell him about kinetic and potential energy.

When in doubt RTFM, he thought. Read the fancy manual. A hundred times he'd gotten that advice, although sometimes the adjective used was something other than "fancy." And the tutorial on simple harmonic motion was the only manual he had. If the answer was anywhere, it had to be there.

He started in on the chapter on harmonic motion, reading from the beginning, working the problems, single minded in his approach. Once he looked up, checked the heads-up display, and realized with a shock that over

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an hour had gone by, three full oscillations, while he hadn't been paying attention. With his attention fully engaged, the material was interesting, he thought, worth studying just for its own sake. He could suddenly see why physicists were so passionate about their work. The solution had to be there, it had to be hiding somewhere in the mystery of kinetic and potential energy.

And it was.

He almost laughed when he finally saw it. It was the swings.

He needed to get serious. He checked his display and realized that he had been studying the physics text for over three hours. The Sun had set. While he hadn't been paying attention, he had made eight trips across the mirror and back. He checked his power level; about nine hours of battery life left. But he had the sequence worked out in his head.

He was lying on his back, sliding downward, so the first thing was to roll over onto his belly. He called up the graph of his position and velocity, watching his progress in the display, and as he approached the bottom, he got ready by pushing himself onto his hands and knees. When his velocity reached maximum, at his lowest point on the pendulum swing, he got up onto his feet.

That was it. That was his plan.

It was a trick to stay upright on the slippery surface for the twelve minutes it took him to slide toward the rim. When he was vertical, he'd raised his center of gravity by perhaps seventy or eighty centimeters. Not a lot.

The rim approached. Standing, he could now see over the rim onto the snow-covered plains, even though he was tilted significantly away from the edge. The snowcat was nowhere to be seen.

Still, though he could see outside the bowl, the surface beyond was still out of his reach. No matter. As he coasted to his momentary hover just short of the rim, he implemented the next phase of his plan.

He sat—or, rather, allowed himself to fall down—and then pressed himself down against the surface of the mirror, trying to squeeze himself as flat against the surface of the mirror as he could manage.

That was it. A small change in center of gravity, but—he hoped—if repeated enough, a significant one. Every time he passed the bottom of the bowl, he raised himself up—at each rim approach, he lowered himself down. It was like pumping a swing; each time he was pushing just a little bit of energy into his motion. Whenever he crossed the bottom, by raising himself up he moved his center of gravity just slightly toward the invisible pivot point of the swing, and his speed increased infinitesimally. When he lowered himself at the rim, he was hardly moving, and so he lost nothing. Each cycle, he would gain just a little energy.

Another cycle: stand at the bottom, drop at the rim. Again. Again. Was the rim closer? Hard to tell. Again. Again. He allowed his mind to go blank, concentrating on nothing other than his moves. He was back on Vesta, back on the swings with his brother, trying to pump the swings enough to race his brother to take the swing up over the bar. Again. Again.

Now the rim definitely was closer—as he dropped down, he stretched his arm out as far as he could, and his fingertips touched snow. Not enough to get a grip, but still, progress. He tried to pull himself up by one fingertip, but no success.

Down. Up.

Again, a little closer; this time he got two fingertips over the rim, and he pulled as hard as he could. Again. Again. Now he could get his entire palm over the rim, and he pushed down with all his strength, pulling himself up and almost succeeding in getting his elbow over the rim before he slid away.

On the next slide, he had both his hands over the rim, he pulled himself up to his elbows, pushed up, then flung his

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knee up over the edge, teetering for a moment and then flopping awkwardly out onto the rim, onto the surface.

He was out.

He was on the surface, spread-eagled in the snow, and wasn't even breathing hard. It had been easy! "Physics," he said. "It's all in the physics." He crawled away, not trusting himself to stand, putting a few meters between himself and the treacherous edge. He checked his power. Almost an hour of battery left, but that was plenty. As soon as he got to the snowcat, he could plug into the cat's power supply. And the cat was—

The bottom dropped out of this stomach. The cat was nowhere near.

He checked the inertial navigation system in his display, disbelieving the figure it was telling him. The cat was twenty kilometers away!

The display showed his position relative to the snow cat clearly. He'd come out on the wrong rim.

He sat down on the snow and checked the display again, and then once again, trying to make it come out right by concentrating. How could he have made such an elementary mistake?

The cat was on the opposite rim, but not precisely across from him. During the hours that he had been sliding across the mirror, the planet had rotated under him. He'd come out on the same side he entered from, but the planet itself had moved. The snowcat was about a 150 degrees around the circumference. That was better than having it be exactly on the other side—it would be only twenty-nine kilometers for him to walk around clockwise, a little less than the full thirty-five kilometers around the rim.

But twenty-nine kilometers might as well have been a thousand, or a million; there was no way he could walk that far in the remaining—he checked his display—fifty-two minutes.

He lay back, suddenly exhausted. How long had he been awake, anyway? He could just go to sleep—

That wouldn't get him anywhere. He sat up again, the emergency protocols played in his mind like a mantra. *First, take whatever immediate actions are needed to prevent the situation from deteriorating. . . .*

He stared out at the black mirror. He visualized where the snowcat must be, on the far rim of the bowl, invisible in the darkness.

. . . Item five: Appraise resources. Apply the resources available in the most efficient way to effect rescue.

The resource he had was one frictionless bowl, perfectly black, perfectly smooth, perfectly frictionless.

It was the last thing he ever wanted to do, but waiting and thinking wouldn't help; all it could do was to delay him, and maybe he would lose his courage. It had to be done now.

He stood up and walked away from the rim, then turned and fixed his eyes on the edge. There it was.

It was the laws of physics again. He had been trapped in the mirror because he had entered it with insufficient energy to get out again. All he had to do now was go straight across, a little bit to the right, but of course he would have to aim further to the right, compensating for how the bowl would shape his motion into a curve. As long as he had enough energy, as long as he entered with enough speed, the mirror would be no trap. If he ran into the mirror, instead of allowing himself to fall, he would come out again.

It was physics.

His hindbrain was screaming to him that it was suicide, but there really wasn't a choice. There never had been. He got a running start and dove into the mirror.

His dive took him on a long flat curve, and in the low gravity he seemed to hang in space, the blackness below him mirroring the infinite depths of space above him, weightless in his arc for a moment that seemed like forever.

And then he hit the surface of the mir-

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ror, sliding, sliding. In his helmet, the display showed his trajectory, projecting his motion across the mirror.

But he wasn't paying attention. He knew his trajectory was right. He could feel it.

At last, when it counted, he had made it over the top. ■

—for Ross Rocklynn

Maybe teachers ought to approach astronomy from a hammock on a deserted beach as well as from the lenses of giant telescopes. The earlier in life we know we are part of something magical and mysterious, the better off we are.

—Jimmy Buffett

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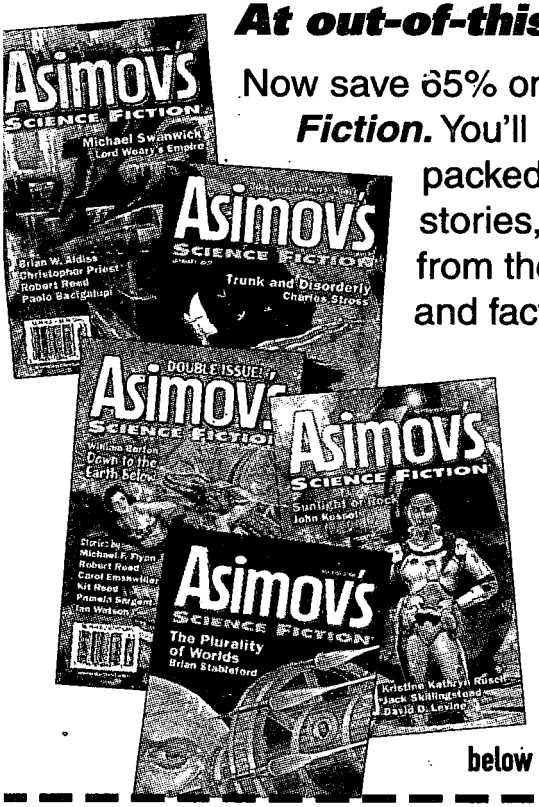

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The Natural World

Don D'Ammassa

Discoveries aren't always made by those in the best position to do something with them. . . .

"I really think you should consider getting an aquarium, Miss Wilson. Then you would be able to enjoy the beauty of God's creation without having to submit to these tedious and unsanitary excursions. These are the 1870s, after all. One doesn't need to be discomforted while viewing the natural world."

Emma sighed and wished once again that she'd been able to find the right words to dissuade Jared Rackham from accompanying them this morning. She and her younger sister, Virginia, were quite capable of looking after themselves and in fact they were both more at ease covering the rough terrain along this part of the shoreline than their ungainly companion. Ever since their arrival from London, he had been appearing with distressing regularity at the cottage. It would not have been such a trial if he'd been content to abide by the customs of decent society and depart promptly after paying his respects and remaining away for a decent interval between visits, but he was clearly enamored with her, although he had not said as much, and returned with distressing regularity. Her polite but firm refusal to respond favorably to his veiled advances had so far made no inroads on his enthusiasm.

"Perhaps you are right, Mr. Rackham, but one can only stare at the same pressed leaves and flowers for so long, after all, and the fresh air and exercise is good for the health."

They had been picking their way across a fairly steep, rocky slope and Rackham had managed to stumble over every third irregularity, giving his

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progress an erratic, uncertain quality. "There is no end to the wonders imbued in even the simplest of His creations," he answered somewhat breathlessly. Rackham had recently been promised a living as curate of Merrivale when the incumbent retired, and had discovered within himself a previously hidden piety. "As to the value of fresh air, I must say that I fear it is most overrated. I find settled air much more conducive to my own health and have not suffered the ague or similar ills since mending my habits."

Emma turned away to conceal her annoyance, and raised a hand to shade her eyes. Virginia had run ahead of them, her long legs covering ground quickly and effortlessly. She would be a stunning young woman once her body had regularized its proportions, but at the moment she seemed even younger than her thirteen years. "Ginny! Please wait for us to catch you up!"

But if Virginia had heard her sister, she chose to pretend otherwise and a moment later disappeared from sight, having reached the crest of this particular rise and descended beyond it. This was the farthest they'd come along the coastline since moving to Seamouth, and the difficulty of the walk had taxed their resolve, but not even this hardship had dissuaded Rackham from accompanying them.

Emma picked up the pace although the backs of her legs were aching and she was breathing heavily. She used a handkerchief to wipe beads of sweat from her forehead before Rackham could see them and launch into another panegyric about the ill effects of overexertion. Given the man's indolence, she was amazed that he had reached the age of thirty without spoiling his figure. He was still quite a handsome man, she admitted, although the effect was quite spoiled whenever he chose to speak.

They reached the crest almost simultaneously, and Emma suppressed a smile when she saw that her companion was mopping his own brow now, apparently too breathless to speak. That suited her own mood precisely, because the vista that opened before them deserved at least a brief moment of silent, appreciative contemplation. The land fell away spectacularly, revealing a narrow defile that seemed to cut down directly into the Earth. From the opposite side, a narrow brook rushed to the brink and toppled over, sending light spray sheeting down over a riot of wildflowers, bracken, various ferns, and twisted vines that seemed to gather all the rest together. Emma experienced a sudden but brief alarm because it looked as though there was no place Virginia could have gone except a deadly plummet into the depths, but then she heard her sister's voice from quite close at hand, calling to her.

"Emma! Come down! You must see this!"

At first, she had no idea how to comply. She appeared to be faced with an impenetrable wall of thorn-bearing shrubbery. A brief investigation revealed this to be an illusion, however. There were overlapping ramparts of branches and stems, but it was a simple matter to move among them once the trick of perspective was revealed.

"I say, Miss Wilson, is that wise?" Rackham made as though to take her arm, thought better of it and hesitated with one hand half raised. "The footing here appears quite treacherous."

"Please don't fret, Mr. Rackham. I shall take care. Please make yourself at ease here until we return." She thought she might escape him at last, if only briefly, but before she'd taken a dozen steps, he stirred himself to follow.

Twice more she had to pause and search for a way to proceed, and on

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several occasions she'd been able to keep her footing only by grasping sturdier branches or gnarled saplings growing out of the cliff wall. It was, indeed, a cliff face they were descending, crumbling and treacherous, and she would have turned back if Virginia had not continued to call from below, even if that had meant admitting defeat to the odious Mr. Rackham.

But at last she reached bottom and saw her sister, crouched at the edge of a pool of water only a few steps away. The hem of her skirt was heavily stained and Emma felt momentary irritation before glancing down and noticing that her own clothing, snagged by thorns and brushed by damp soil, appeared nearly as disreputable.

"Come over here, Emma. Look at this!"

Waves crashed against rocks only a few meters away, but the sound was muted by the convolutions of this sheltered cove. There were several brackish pools near at hand, and occasional droplets of sea spray speckled their surface. The foliage above them had formed into a canopy, and it was almost as though they'd stepped forward through time into dusk.

"Oh, there you are!" Rackham came up behind her so precipitously that he brushed against her arm, perhaps inadvertently, and she instinctively drew away. But for once she wasn't irritated by his advent, because she was so overwhelmed by the new environment in which she found herself. It was like a great, natural cathedral, the riotously colored plants mimicking stained glass, the filtered light from above, the muffled sounds of the outside world. "I don't look forward to ascending again," said Rackham, apparently unaffected. "The footing is quite treacherous. I should think the local council would have erected some sort of barrier, or at least a warning sign."

Emma refused to let his tedious chatter spoil her mood. She moved toward her sister, picking her steps carefully. There was water everywhere, and any solid ground was covered with delicate plants, which she did not want to crush under her feet. Fortunately, a scattering of smoothly worn rocks was profuse enough that she could pick her way from one to the next.

Virginia was still crouched in the same spot when Emma joined her, and at first the older sister failed to see what was so interesting about this particular location. It was the largest of the pools, certainly, and the deepest as well. Although the others had irregular, amorphous outlines, Virginia's pool appeared to be an almost precise circle three meters in diameter, as though something small but very heavy had fallen from above, creating a shallow crater upon impact. There was no shore on the far side, which butted up against a nearly vertical fall of rock, but the near side was bordered by fine sand of a sort not in evidence anywhere else within sight, at least not in such quantity. It might have been a miniature of a wading beach.

But the most striking sight was the object at the center of the pool. "What is that?" asked Rackham, following in her wake.

"I'm sure I don't know." It might have been a lump of earth except that its shape seemed too regular. There was a central cap, its highest point, extending a hand's width above the water, surrounded by a spiraling series of tubes that wound around the core, extending its circumference until it displaced fully a third of the pool. The entire visible surface had a dull, red tint so unvarying that it seemed impossible for it to be natural. "It looks like an oversized sea shell."

Virginia gestured impatiently. "Come here, please, Emma. I think it's almost done."

At last Emma crouched beside her

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sister and saw what it was that so fascinated her. A narrow finger of that same odd hue ran along the floor of the pool, emerging from the water where it lapped against the sand, then extending across it in a straight line toward a stand of ferns. A jagged rock had fallen from somewhere above, severing what Emma could now see was a hollow tube. "What is it? Some kind of pipe?"

Virginia shook her head. "No, I think it's a tunnel. Look there."

Emma hadn't noticed the secondary line, two of them actually, originating on opposite sides of the obstruction, now very close to meeting. Something glittered and Emma blinked, then focused and saw a jewel spill out of one end. No, not a jewel but an insect of some kind, a beetle perhaps, which sparkled red and purple and green as it moved. One end of the insect's body dropped to the sand, which stirred as though touched by the faintest of breezes.

"What in the world is it doing?"

"Just watch!"

It only took a few seconds. The insect straightened up and then pressed its opposite end—Emma couldn't see a distinct head—against the opening of the tube. Slowly, but visibly, a red hued paste emerged, clung where it was applied, and almost immediately hardened. The diminutive engineer then disappeared inside the open end, presumably to make some modification inside. A second, nearly identical creature had emerged from the other termination point and was performing identical duty there. A few more applications and the tunnel would be restored, bypassing the fallen rock. The newcomer varied from the first only in that one of its hind legs was missing, although it seemed to get along on five just as well as on six.

"That one appears to be injured," she said quietly.

Virginia nodded vigorously and pointed. "Look there, at the edge of the stone. Do you see? There's a leg, or part of one, caught beneath it."

Emma leaned forward, squinting, and confirmed her sister's observation. "Indeed, it must have been caught when the stone fell and perhaps gnawed its own leg off to get free."

"What a horrid thought, Miss Wilson!" Rackham seemed positively repelled by the idea. "But I suppose God spares these lesser creatures the pain and anguish that are our lot."

"Whatever could they be, Mr. Rackham? I've never seen their like before and I've read all the natural histories."

Rackham leaned forward, peering myopically. "Some sort of beetle, I'd say. Or a water insect related to the pond striders."

Emma clucked her tongue impatiently. "I wouldn't imagine that a water-related creature would take such great pains to keep its feet dry, so to speak, Mr. Rackham. This seems more akin to the termite or the common ant, although its appearance is certainly uncommon enough."

Rackham sniffed to convey a sense of his bruised dignity. "I wouldn't pretend to understand God's purposes in these matters, Miss Wilson. I'm sure that whatever this creature is, it fits into His plan as perfectly as does the moth or the caterpillar. The role of the naturalist is to observe and appreciate, not to presume to explain Creation, Mr. Darwin notwithstanding."

Virginia turned away to conceal her distaste for Rackham, rising slowly to her feet and stepping away from the water. "It leads back in this direction." She tentatively pushed a branch out of her way, but the undergrowth was much thicker here, virtually impenetrable. "We have to find a way around this lot."

"Whatever for?" asked Rackham, who had grown somewhat agitated. "I think we should go back. We wouldn't

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want to try that ascent in the darkness."

"Calm yourself, Mr. Rackham. We've barely digested our mid-day meal. We surely have time to indulge ourselves and I for one would like to rest a bit before any further exertions."

"I suppose a brief respite would do us all some good," Rackham admitted, but he was sulking.

With the same instinct that had led her down to this place, Virginia had found a circuitous but relatively accessible route around the obstruction to another clear space deeper in the chasm. At first it appeared that she had gone too far and outstripped the beetles' construction project, but then she spotted the thin red line running along an eroded notch before it disappeared into another bush.

Emma was close behind with Rackham reluctantly bringing up the rear. Tiny flying insects buzzed around them now and Emma waved them away, consoling herself with the knowledge that Rackham was similarly encumbered. Even so, she almost called on her sister to stop when Virginia began pressing herself around this latest obstruction, smearing her dress with fresh daubs of dirt as she brushed against the cliff face. But before she could do so, Virginia was gone again, passing through into a natural chamber so murky that when Emma followed she could barely make out her surroundings until her eyes began to adjust.

When she could finally see, she gasped.

The two sisters stood side by side, Rackham a step behind them. Directly in front of them, and nearly as tall as they, stood a dull red pyramid. The sides were cut up into tiers with ramps connecting one to the other like a giant model of a ziggurat, and at numerous points there were dark recesses, presumably access to the interior. The jewel-like beetles swarmed over its surface, engaged in enigmatic tasks, many carrying leaves and twigs and flower petals, dragging them inside the pyramid. It was too dark to see much of the base of the structure, but there was at least one connecting tunnel on this side, probably the one they'd been following, and one or more additional tubes beyond, stretching back into the farthest recesses of the chamber, which appeared to have no other exit.

"This is most extraordinary," said Emma. "I do believe we've happened upon an entirely new species."

"I don't think that's possible," said Rackham dryly. "I'm sure that our English naturalists have them catalogued and dissected somewhere. One can't just meander about discovering new insects, you know."

"Are you trying to say that there is a limit to God's creation, Mr. Rackham?"

"Certainly not, but we know the size of the Ark and common sense tells us that there must have been a finite number of animals which could have been accommodated."

He seemed prepared to lecture on this point indefinitely, so Emma took advantage of his momentary pause to change the subject. "What's going on over there?" She pointed past Virginia to where a particularly heavy congregation of the beetles had gathered. They edged around the corner of the pyramid, stepping deeper into the shadows.

The beetles had to deal with another obstruction. Climbing vines had pulled down part of a dead tree, one branch of which had come to rest on the edge of one of the tiers. It would have been a simple matter for a human to shift the weight of the branch, which was only as big around as a human thumb, but for the beetles, it was a major obstruction apparently beyond their capacity.

A small contingent labored for quite some time without making any

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progress. The three interlopers watched for several minutes as the beetles jostled about, apparently undiscouraged by their failure.

"Can they possibly move it? Let's help them," said Virginia, but Emma grabbed her arm.

"Wait! Let's see what they decide to do next."

Rackham made an annoyed sound. "Really, Miss Wilson. They're only insects. They're not capable of deciding anything; they act entirely on instinct."

She ignored him. So did the beetles.

It was obvious that the work team lacked sufficient mass, a failing they somehow managed to communicate to the rest of the colony. Most of the tiers were relatively empty of traffic, but suddenly they were overflowing with tiny glittering bodies. Beetles emerged from the openings in the pyramid in a fluid rush, hundreds at least, more likely thousands, all streaming toward a single goal. The movement was so sudden and massive that all three of the humans backed away, although there was nothing to indicate that they'd even been noticed.

The swarm reached the broken branch and congealed around the original work team. There was a sudden light scratching sound and the obstruction began to move and was soon pushed over the side. It fell to the ground and bounced away.

As quickly as the horde had appeared, it dispersed, leaving behind only a small crew who methodically began to secrete a sticky substance with which they began patching the small scrape marks visible on the pyramid's exterior.

Emma and Virginia clapped their hands together in applause, but Rackham had grown jealous of the beetles for gaining the attention he would prefer directed toward himself. And then he made a terribly unwise decision. He snapped off a piece of a dead branch and began poking it into one of the openings in the pyramid. The sisters both called for him to desist, but he had grown increasingly miffed at their indifference to his presence.

At first it seemed that he would provoke no response, but then one of the beetles emerged, others following, some of them mounting the stick and rushing along it toward Rackham's hand. Their speed and purposefulness caught him by surprise and he backed away, but he still held the stick and the first of the beetles had nearly reached his fingers. With an inarticulate cry of disgust, he threw the stick down at his feet and, before the sisters realized what he intended, had raised his foot and brought it down squarely on top of his diminutive enemies. There was a faint popping sound and when Rackham stepped back, they could see the ruined body of at least one beetle lying in his boot print.

Something changed around them. There had been an almost inaudible susurration, so low that they hadn't been aware of it until it ceased. Emma glanced toward the pyramid and saw that all movement had stopped as well. There were scores of beetles in sight, but they were uniformly motionless. She had a sudden presentiment of danger but before she could put voice to it, the movement resumed.

Beetles streamed from the pyramid, heading toward the threesome.

Emma and Virginia pushed their way through the leafy barrier, heedless of the damage they were doing to their clothing. Virginia stumbled and fell to a knee and Emma hastened to help her up. She turned to see Rackham follow in their wake, but it was a strangely altered Rackham. Scores of beetles clung to his clothing and his face was twisted in an expression of horror and loathing. He opened his mouth in what started as a scream but which turned into a horrible choking

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sound as several of the beetles raced up his chest and swarmed over his face. Rackham's look of surprise was almost comical as he staggered forward a few steps, then fell full length.

The sisters were transfixed, too startled and fearful to intercede for the first few seconds. Emma finally rallied, ordered her sister to remain where she was, and cautiously advanced. Rackham lay prone, moving his limbs slightly though to no great purpose, and moaning ever so softly. She had no clear plan to drive the beetles away from his body, but that proved unnecessary. They were already leaving, streaming back toward the pyramid.

"Are you all right, Mr. Rackham?"

There was no answer for several seconds and she was about to address him a second time when he slowly raised his head, then pressed his palms down and lifted his upper body. His expression was still anxious, but he was no longer ruled by panic. "What happened? Are they gone?"

"I think so. Have they done you any injury?"

Rackham rose to his knees, coughed, cleared his throat, then examined himself critically. "Only to my dignity. Mrs. Nelson will never be able to clean this suit adequately, I'm afraid, but I seem to be uninjured." He glanced around nervously. "Are they entirely gone?"

"I think so, but we should probably leave now. Are you up to it?"

Rackham waited until he was standing before answering. "I think so, yes. They took me by surprise, you know. Silly of me to become so rattled by one of the least of God's creatures."

Emma bit her lip. "Least or not, I really think we should absent ourselves before they return. Are you certain that you're all right?"

"Quite, my dear. A tempest in a teapot."

The return trip was uneventful, but Emma had never felt so tired and dispirited in her life, and the sisters confined themselves thenceforward to more conventional adventures and shorter excursions. Virginia mentioned the beetles from time to time, but Emma had no wish to be reminded of them, agreed that they had been quite beautiful, and quickly changed the subject.

Rackham seemed fully recovered, and resumed his regular campaign of visitations. His resistance to any outside excursion strengthened and he began to complain that direct sunlight disagreed with him, but Emma saw nothing extraordinary in this. In the past, he had tried similar ploys to discourage them from venturing away from the house. He had always enjoyed a delicate complexion, he explained; and Emma did notice that he seemed very pale, so much so that she inquired after his health. "Quite good, my dear. The spirit of our Lord lends me some of its vitality."

Midsummer passed and Virginia was sent off to spend two months with their mother's sister, who had had a difficult pregnancy and needed help with the infant. Emma had been so far unable to make any friends among the local youth—in part because her father frowned upon most such associations—and her parents were so much taken up in their own affairs that she was left to her own devices almost every day. She began to feel so lonely that even Mr. Rackham's visits became welcome distractions from her growing malaise.

And eventually she felt a quite surprising unhappiness when they began to decrease in frequency and eventually stopped entirely.

Emma felt no attraction to the man, and counted him not even as a friend, but she had been flattered by his infatuation and felt a sense of distinct loss when it was withdrawn. On those occasions when she could find an ade-

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quate excuse to visit the village, she made painfully casual inquiries about his welfare, but elicited no intelligence other than that he spent a good deal of time by himself in his cottage and that Mrs. Nelson, who cleaned and cooked for him, said that he had become more studious and reclusive than ever.

She asked about this one day when she encountered Mrs. Nelson in the market.

"Yes, lass, he's a very changed man of late, he is. Keeps to himself, though, and doesn't find fault with my work. I have nothing to complain of." Emma could tell that Mrs. Nelson wished to speak further but required prompting.

"I imagine he's preparing for his curacy. That must take up a good deal of his time."

The older woman nodded. "He tells me all the time that he feels the presence of God within his breast. He's righteous enough, I suppose, though a bit Popish in his practices."

"Whatever do you mean, Mrs. Nelson? He seems quite a proper churchman to me."

It required a bit more enticement, but Mrs. Nelson was clearly primed to tell someone of the strange goings-on at Rose Cottage, where Rackham was ensconced. She had noticed a slow evolution of his behavior during the past several weeks, the individual increments of which had not been alarming but which were, when taken as a whole, somewhat troubling.

"I can understand him locking himself in his study for hours at a time, studying on his books, what with the responsibilities he'll assume within the year. But I'm not so convinced that what happens in the root cellar is entirely respectable." Emma was forced to prompt her again at this point, and their conversational tug-of-war continued until she had the outline of Rackham's strange behavioral transformation.

Mrs. Nelson had arrived one day to find the door to the root cellar reinforced and padlocked. As it happened, her duties did not require that she have access to that portion of the property, which was used only to store wine and a few odds and ends, but she thought this new security unusual enough that she remarked upon it to Rackham, who assured her that it was simply a safety precaution. "Those old steps were rotted through and might collapse at any moment." Although she had accepted his explanation, subsequent events contradicted it. "Sometimes while I was cleaning up, Mr. Rackham would come out of his room and go into the cellar. He told me that he was repairing the steps, and that he was barring the door from below so that I wouldn't fall to my death in a moment of forgetfulness." She leaned closer and gave Emma a conspiratorial look. "But I never heard no hammering or any other sound, for that matter. And he always wore the same thing, a raggedy old robe like those monks up at Christwarden Abbey wear. I think he was down there kneeling in the dirt, saying prayers, and if that ain't Popish, then I don't know what is."

Emma admitted that it sounded odd. "But I'm sure Mr. Rackham is entirely orthodox, Mrs. Nelson."

More days passed. Emma finally made a local friend, Mary Waddell, the mayor's niece, and through her, Mary's fiancé, Roger Hornby, and several other young men and women. A few of the men were interesting, but otherwise committed, and others seemed to find Emma's company appealing, but they were uninteresting. This unhappy state of affairs was still preferable to her former isolation, and her new social life was sufficiently engaging to take her mind off Mr. Rackham until late in the fall.

She was in the market again, run-

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ning an errand for her mother, when she saw Mrs. Nelson at a fruit vendor's stall and recollected her former acquaintance. "And how is Mr. Rackham doing these days?"

"And how would I know that, Miss, seeing as I've not set eyes on the man for these last eight weeks?"

Emma's brow wrinkled. "But aren't you his housekeeper still?"

A vigorous shake of the head. "He sacked me, lass, and without a hint of a warning. Told me to get out and never come back."

"But why? Was he unhappy with your work?"

Mrs. Nelson looked affronted. "He had no reason to be, and I've not had a complaint out of him or any who came before him. One morning I came to his door just as I always did, and he was waiting for me. My services are no longer required, he tells me, and other arrangements have been made." She grunted heavily. "Other arrangements indeed. There's not a working woman in the village gives as good service, if I do say it myself. And he's not had in any other help either. I'd have heard."

"But surely someone must cook for him, clean his house? Mr. Rackham is not the sort of man who could do for himself."

"Can't say that I would have thought it myself, Miss, but there it is."

Emma decided that she must find an opportunity to call upon Mr. Rackham personally and find out the truth of the matter. He may have made a pest of himself in the past, but he'd never done her a disservice and it was her Christian duty to inquire further as to his welfare.

But then Virginia returned from her brief exile, and Emma was introduced to Thomas Wallenby, son of Sir Arthur Wallenby, and more time slipped away with no investigation of Mr. Rackham's odd behavior.

Emma Wilson gave no further thought to Jared Rackham until the day her father mentioned the new curate in Merrivale, Robert Bowlby.

"But I thought that position had been promised to Mr. Rackham?"

Her father had shaken his head. "Strange situation that, Emma dear. It seems that he turned the post down at the last minute."

"Then perhaps he had a better offer."

"Wetancourt says otherwise." Wetancourt was the innkeeper. "Apparently Rackham spouted some nonsense about serving God more efficiently right where he was. Sounds a bit daft to me, but there's talk in the village that he's gone Romish and is set to enter a monastery or some such."

Her father had no further information, which did not prevent him from expounding on the subject for several more minutes, but Emma barely heard what he said from that point on. She had silently resolved to herself to pay a visit to Mr. Rackham and learn the truth from his own lips.

The opportunity to follow through on her promise did not present itself for several more days. First she was required to accompany the family on a brief but tedious visit to her father's brother, a tiresome man who had never married and who still treated Emma and her sister as though they were children. Then they returned to discover that the servants had quarreled in their absence and it required a firm hand and some understanding to restore peace and efficiency to the household. And there were various other social obligations that must be satisfied.

But at last Emma found herself left to her own devices for a day and, with nothing to compete for her attention, she set out alone and on foot to visit Mr. Rackham, an impropriety which would have shocked her parents but

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which, in these modern times, seemed to her quite acceptable. Her parents were visiting the Wheelers and would not be back before dark, and Virginia was off somewhere with her newest companion, Evelyn Lane.

Emma had never actually been to Rose Cottage before, although she had certainly passed it often enough. The name came from the climbing roses that swarmed over its walls, so profuse in growth that only the roof of the cottage was visible from outside the property. There was a gate, of course, but it was open. Emma noticed with growing dismay that the grounds had not been tended in some considerable time. The modest gardens were overgrown, and a sizable branch had fallen from a tree and partially blocked the pathway to the door. She stepped around it and continued, determined to discover the truth of Mr. Rackham's situation.

The door stood slightly open, a circumstance that caused her some concern. Emma raised one gloved hand to the knocker. There was no response,. not a sound from inside, so she leaned forward and called out his name. "Mr. Rackham? Are you at home? It's Emma, Emma Wilson. I came to see how you were faring. Hello?"

She paused, listening, but there was no response. Her first impulse was to leave, but she'd invested considerable time and effort in this venture already and besides, Mr. Rackham might be lying sick or injured and unable to respond. She pushed against the door, which swung further open, and started to call again.

But she stopped in mid-syllable, aghast.

She had a very limited view of the interior, but circumscribed though it was, it still revealed the terrible conditions inside. A table and lamp stood under a large painted landscape, beyond which stood a chair, a mirror, and a doorway. By shifting position slightly, she caught sight of a portion of a tapestry, another chair, and a second doorway. Every object, as well as the floor and walls, was covered with filth. The interior of the house was if anything in worse condition than the grounds. Appalled but fascinated, she deliberately opened the door wide.

Dirt lay everywhere, not the patina of dust left by neglect but a perceptible layer of dirt as though a flood had coursed through the hall, leaving a filthy detritus in its wake. Something terrible had happened here. Emma knew it instinctively, and her concern for Mr. Rackham's fate overwhelmed her sense of caution.

She stepped inside, calling his name. There was still no answer.

The arrangement of rooms was unfamiliar to her, and there was such a thorough application of dirt throughout the cottage that it was sometimes difficult to tell one from the other. Every surface was covered, sometimes with a thin layer, sometimes with actual mounds including a particularly large one in what was presumably Rackham's sleeping chamber. But in due course she found herself in the kitchen, having seen no trace of her quarry elsewhere. Nor was he here, but there was a narrow doorway that did not lead to the outside. This door too was open, and a brief look told her it provided access to the root cellar. Somewhere below, a lamp had been lit, because formless shadows danced on the near wall.

"Mr. Rackham! Are you down there? Please answer me. Do you need assistance?" No one answered, but there was a faint rustling. "This is Emma Wilson. Are you hurt? Can you answer me?"

She placed a foot on the top stair, which creaked slightly but seemed secure. Another call brought renewed muffled stirring but nothing else. Emma bit her lip. Logic told her that she should return to the village and

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seek help there, but what if she raised an alarm unnecessarily? She resolved to descend far enough to survey the cellar and no farther.

Once the decision was made, she didn't hesitate. She did, however, watch her footing carefully because there was dirt on the stairs just as everywhere else, although it was so hard packed here that it seemed almost like carpeting. Within seconds she had descend more than half way and, by ducking her head slightly, was able to see much of the space around her.

If anything had been stored in the cellar in the past, it had either been removed or concealed under enormous piles of dirt. The top of one mound had been leveled off to serve as a platform for an oil lamp, which accounted for the flickering shadows. There appeared to be a second light source further off, but the cellar was L-shaped and she could not see around the corner. Beneath the staircase, wooden boards, an old barrel, broken glass, and other debris had been piled together in a chaotic mass. Rackham was nowhere to be seen, but there were signs of excavation and, not far from the foot of the stairs, one of the supporting beams had apparently fallen. There was a hint of color to one side of the beam and a shape that she recognized with sudden shock as the ankle and heel of a human leg. Emma promptly forgot her resolve not to descend all the way and hastened to investigate.

It was indeed exactly what she had feared. The beam lay across the knee and lower thigh, pinning them to the earthen floor. It didn't seem possible that the rest of Rackham's body could possibly fit into the shallow space beyond, but she didn't investigate. The condition of the flesh of the foot was sufficient to convince her the accident had occurred some considerable time in the past, and that there was nothing she could do for Rackham now.

But if that was the case, who had lighted the lamp? The rustling she'd heard might well have been rats or other vermin, but the lamps would not have lasted the day without being refilled. With the thought came another brief, furtive sound, from the pile of trash behind the stairs.

Although she was badly shaken by what she'd already seen, and certainly had no desire to encounter a rat in its lair, Emma found herself moving not to the stairs but instead toward the hidden branch of the cellar.

Even before she reached it, she noticed something familiar and disquieting. The walls had changed color, slowly becoming a uniform red, a familiar shade that she could not immediately place. Then she was around the corner. The second lantern was set in another column of dirt near the far wall, but the wall was no longer the delimiter of the cellar. A circular hole had been excavated through it, descending at a modest angle into the earth, and the walls of that hole, and the tunnel beyond, were covered with a smooth, almost ceramic layer of red hued material. It was then that she found the elusive memory and realized that it was the very same color as the tunnels of the beetle colony they'd stumbled upon the previous spring.

Emma knew that she should leave, but her curiosity was too great. She must know what lay within that tunnel. If she simply bolted and raised the alarm, she would certainly never be allowed to re-enter and see for herself. Drawing a deep breath, she stepped forward, caught hold of the lantern, and passed through the entranceway.

The slope descended only a few steps before leveling off, then debouched into a circular chamber where, to her amazement, she found a third lamp, also burning. But unlike the rest of the cottage, this space was almost immaculate. The walls, which

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curved into a domed roof, were smooth and red and seemed to be highly polished, as was the floor beneath her. But the real source of wonder was the structure that dominated the center of the room.

It was a perfect pyramid, constructed of the same material, with a single dark opening just large enough that she might have crawled inside if she'd been so disposed. But even Emma's curiosity had its limits. Without taking her eyes off the bizarre structure, she took a step backwards, intending to retreat.

"Beautiful, isn't it?"

Emma spun around, nearly dropped the lantern, and caught her breath when she saw Jared Rackham standing just out of reach. Her first reaction was astonishment that he was alive; her second, shock, because he was completely naked, although his body was so heavily encrusted in filth that in the dim light it almost seemed that he was clothed.

"Mr. Rackham! I thought some harm had come to you!" In fact, she still did. He was certainly not in his right mind. The fact that he kept his distance did not appreciably diminish her alarm at his appearance.

"Harm! No, of course not. I am perfectly all right. More so than ever, my dear Miss Wilson." He casually lifted his hand and filled his mouth with a handful of dirt, swallowing it almost immediately. "I am filled with purpose. I feel God moving within me every minute now. My life has direction and I have penetrated the fog of ignorance and seen the truth. For years I longed to understand the nature of the Creator and it is only now that I have come to realize that I was lost in a search for myself." He stepped forward and swept his arm out, indicating the pyramid, or perhaps the chamber as well. "I am the Creator, you see, and this is my Creation."

Emma had retreated instinctively although Rackham did not seem to mean her any immediate harm. She also noticed that he lurched rather awkwardly when he moved, and she observed belatedly that there was something slightly wrong with his legs, which were both covered with a red hued encrustation. The temptation to avert her eyes was strong, because he was altogether indecently exposed, but she persevered and realized that his right leg was noticeably shorter and more slender than the left. How could it have withered so when he looked otherwise hale and hearty?

And then she remembered the crushed leg at the other end of the cellar and realization made her heart race. The leg had not withered; it was being re-grown. Rackham had been caught by the collapse and had somehow severed his own limb. But how was this regeneration possible? Emma had no idea, but she knew that whatever mechanism might be involved, it was certainly no holy miracle.

"I must be going now, Mr. Rackham. I just stopped by to see if you needed anything, but I'm expected home." She caught her breath and stepped forward, but Rackham continued to stand in her way. "Let me pass, please."

"The work has taken much longer than I expected, but now that you've come to help me I'm sure that it will go much more quickly." His expression changed. "You are here to help me, aren't you?"

"Yes, of course I am. But not just this moment. I will return in due course, Mr. Rackham. Now please let me pass."

For a moment she thought he would do as she bid. He nodded, but it was to some inner voice that was audible only to him. "You must stay and help me."

"And I will do so, at the proper

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time. I have other responsibilities to attend to first." Her voice sounded wrong and she realized that she was afraid.

Rackham seemed to be considering her words, but only for a moment. "There is nothing in this world more important than the Creation. Perhaps when it is complete, there will be time for other considerations, but nothing must interfere with its progress." He raised his arm, perhaps to point to the pyramid once more, perhaps not, but Emma interpreted it as an attempt to restrain her and she responded without thinking, turning to one side and swinging the lantern with her arm fully extended.

Rackham managed to duck away, leaving a gap through which she attempted to escape, but Rackham caught a fold of her dress with one hand and she staggered, nearly losing her footing. He would have had her then, but the dress ripped and the disparity between his legs proved his undoing. He stumbled, off balance, and lost his concentration as well as his grip as he tried to recover. Emma swung the lantern a second time; it barely grazed the side of Rackham's head, then struck the wall of the tunnel. Glass shattered, metal tore, and flaming liquid splashed out like fingers of fire.

Emma ran up the sloping tunnel into the cellar and then to the stairs, stumbling in her haste to ascend. She didn't stop until she was out of Rose Cottage and off its grounds, then collapsed under a tree not far distant, exhausted both physically and emotionally. When she glanced back the way she'd come, a thick column of black smoke was already rising above the wild roses.

She stopped by a brook to wash her face and repair as best she could the damage to her clothing. The dress was no doubt ruined, but it would pass muster from a distance and if she was lucky, she'd have time to repair the situation before she was found out. It had already occurred to her that no one would ever believe her story, and that it would be best not to be connected in any way to the fire that had presumably destroyed Mr. Rackham, or whatever he had become, and Rose Cottage.

Arriving home, she quickly changed clothing and dropped what was not salvageable into the rag bin. Then she made herself some tea and sat quietly, waiting for the trembling to leave her hands and the images of Rackham to leave her mind. She was still sitting there when Virginia arrived.

"Oh, tea! Is there more? I'm quite famished."

Emma was relieved to discover that she could carry on a normal conversation and inquired about her sister's day. Virginia had taken Evelyn on one of her famous nature walks, apparently, but Evelyn was not used to such exertion and confessed herself quite "fagged out." She'd gone home to soak her feet.

"Oh, I almost forgot." Virginia's hand plunged into the pocket of her sweater. "I brought you a present." She brought out a small, ornate box and set it on the table.

"What is it?" Emma peered down, wondering whether or not she was meant to take the box.

"Well, open it, silly. I know you'll be surprised."

With a faint smile, Emma picked up the box and shook it. There was a rattle, as though some small, hard object were imprisoned inside. The clasp was brass and rather stiff, but she pushed it up with her thumb and it opened.

"Be careful! Don't let it get away!" Virginia shouted.

But the belated caution did no good. The moment the lid popped up, the jeweled beetle inside leaped from in-

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side the box to the back of Emma's wrist. Emma's mouth opened wide in surprise and shock, and the beetle jumped again, searching for the nearest place where it might be sheltered from the abrasive sunlight.

Emma choked and swallowed and felt God moving within her. ■

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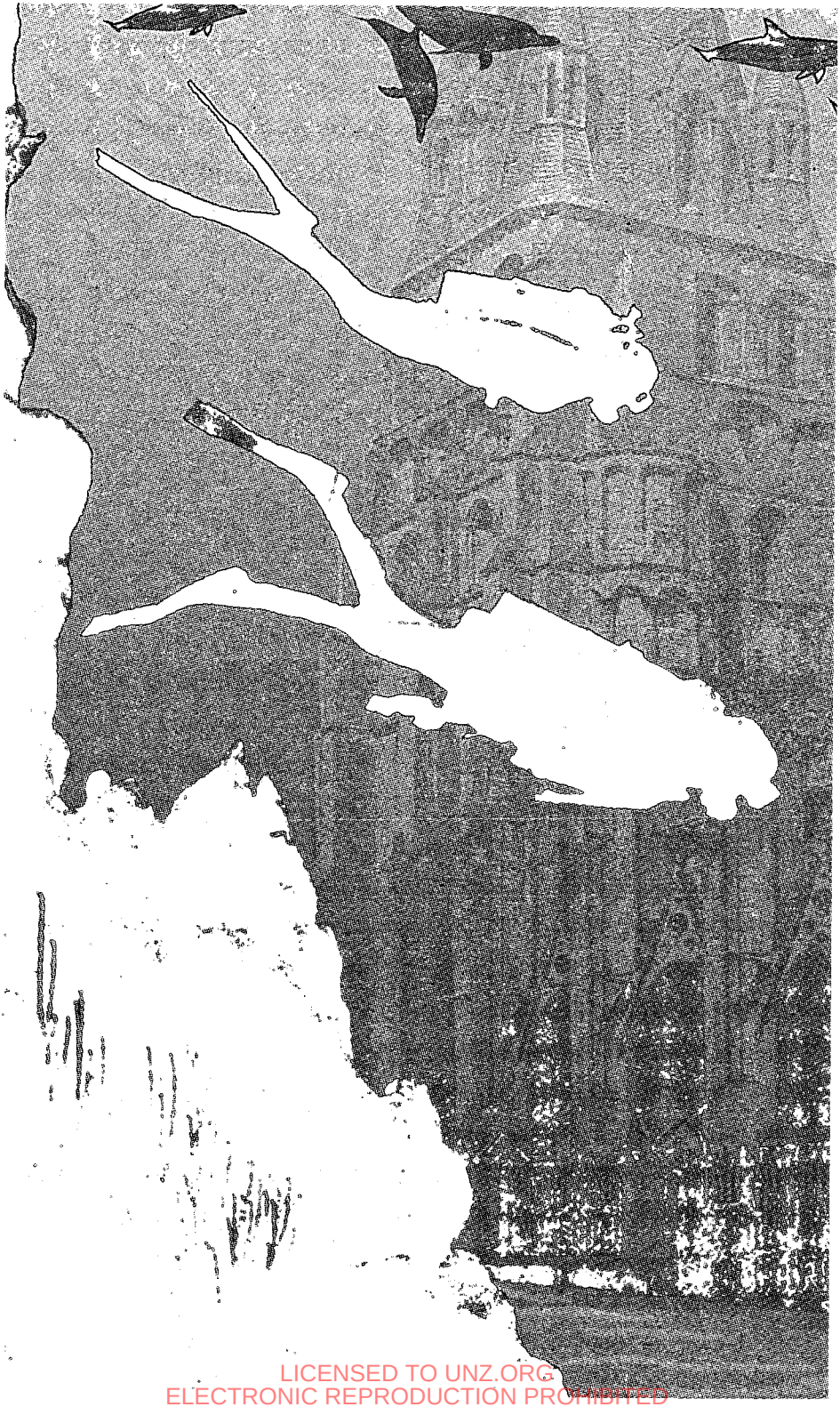

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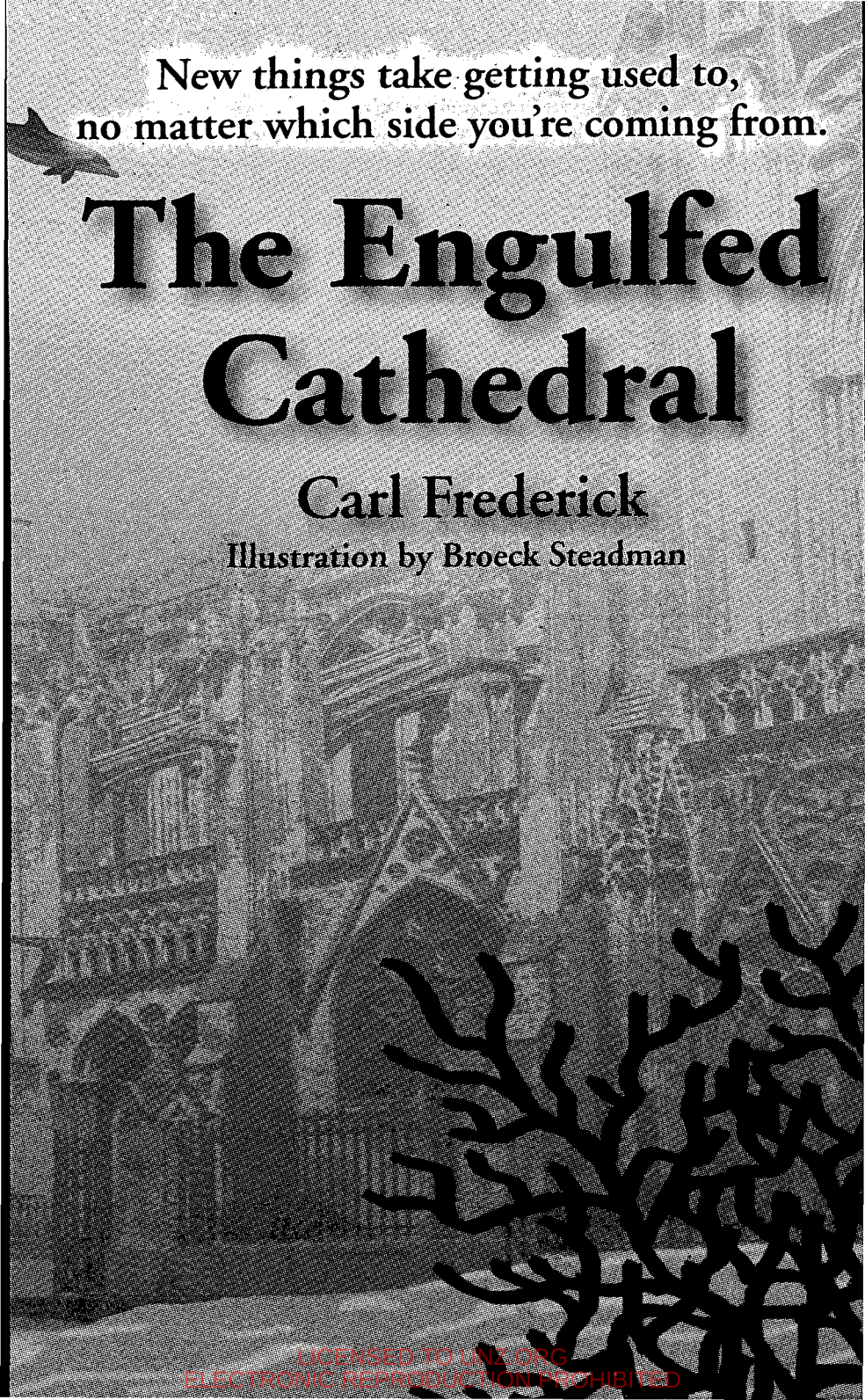
New things take getting used to,
no matter which side you're coming from.

The Engulfed Cathedral

Carl Frederick

Illustration by Broeck Steadman



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Issuant from the warm, clear waters of the Eastern Mediterranean, six meters of white stone breached the surface—the pinnacle of a cathedral's spire. Scattered in a roughly circular array around that gothic steeple lay a few score of boats: pleasure craft, houseboats, and a light military vessel—an aged La Fayette class frigate.

The cathedral, gradually engulfed as the Earth warmed and the waters rose, had survived its baptism intact—except for the north transept, the left arm of the cross. The land subsided and the transept crumbled cleanly, leaving a great open archway to the sea. Now, through that arch swam Doctors Paul and Ingrid Ryan: two delegates to the Thirtieth International Conference on Genetics and the Future of Mankind being held in a beachfront hotel.

As he swam through, Paul looked up over his shoulder at the ceiling of his world: the coruscating plane of brightness interrupted by the black embossed outlines of the boats. Near some of the hulls, he saw starbursts—the silent splashes of divers descending to attend the ecumenical service. In the far distance, a pod of super-dolphins sped away from this unlikely hub of human activity. He wondered what was going on in those cetacean brains of theirs—and he felt oddly uncomfortable not being able to interpret the dolphins' body language; reading body language had, of late, become second nature to him.

Paul directed his gaze to his wife swimming ahead. She appeared larger than life, a magnification caused by the properties of light rays refracting at the water/glass/air boundary of his diving mask. He smiled, conscious that he was a physicist among geneticists. Ingrid was the geneticist of the family and he'd been invited to the conference as a courtesy to her.

Floating at the clerestory level of the cathedral high above the altar, Ingrid looked stunning, divine; an angel with wings replaced by scuba tanks. Her blond hair undulated with the rhythm of her limbs and her body, unencumbered save for her scuba, flippers, wrist dive calculator, and a bikini, seemed a moving work of sculpture. She was beautiful—but then, in some respects, she'd been engineered to be.

She whirled around, facing him, and signed, "Beautiful!"

He started, then realizing what she referred to, signed "The cathedral: Yes. Very beautiful."

Her body language showed humor and he could well imagine her green cat's-eyes wide with amusement behind her mask. Those eyes, with their slit-like irises and reflective tapetum lucidum retinas, were "genetic enhancements" chosen by her ailurophile mother. But due to a then-unknown gene-linking, those cat's-eyes caused her to be born deaf. And the form of deafness couldn't be ameliorated with a cochlear implant.

Here in the water though, deafness was not a handicap—quite the contrary. Unlike most divers, rendered mute by the mouthpieces between their lips, Ingrid and Paul could converse. They used Ingrid's first language and Paul's third: American Sign Language. At home on their houseboat, Paul, using cued English, relied more on Ingrid's lip-reading ability, but because they spent much time together diving he'd become fluent in ASL.

Ingrid resumed exploring the upper reaches of the cathedral's nave. Paul followed and then heard the dull dissonance of a cathedral bell sounding through water.

It disconcerted him that he couldn't tell from where the sound came. The physics was clear: Since sound travels four times faster through water than in air, the time difference for sounds reaching each ear is too small for the brain to determine direction. Knowing the science, though, just strengthened his belief that by design, people were ill adapted to the undersea realm. He bit hard on his mouthpiece, recalling Ingrid's view

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that by engineering, people could be made as comfortable in the sea as dolphins.

Again the bell rang, drawing his attention to its significance.

He swam ahead, catching Ingrid's attention to sign that the service was about to begin and they should probably drop down to get mooring spots above a front pew—so to be close enough for Ingrid to read the Voice-Recognition-to-ASL monitor.

Ingrid smiled with her body. "So you don't have to translate for me?" she signed. Without waiting for a response, she swam away and downward.

As he watched her descend, he wondered if her abrupt departure had a subtext. They had argued again about children. Despite her deafness caused by genetic engineering, she still wanted children engineered for beauty and intelligence. She'd said that for competitive reasons it was almost required these days. Paul scowled under his mask. He wanted no designer progeny. *Tall and attractive are so common now that they're no longer attractive.*

Ingrid swam in front of the cathedral's great rose window and became bathed in the reds and blues from the stained glass—from shafts of sunlight that had traversed vacuum, air, and now, water. Seeing Ingrid against the religious imagery, Paul was reminded of his parents' warning that there'd probably be trouble if he wound up marrying an unbeliever.

Paul gave an internal shrug and, releasing more breathing bubbles than he'd needed to, he followed Ingrid down toward the buoyant tethers. The tethers floated about ten meters above the pews at a depth below the surface that was still safe for the recreational divers.

He could see clearly to the cathedral's floor. No surprise, as the salinity of the Mediterranean is higher than the Atlantic Ocean. That limits algae, which results in higher transparency. The Secchi depth, the depth to which one could see from the surface, was a lot greater than the cathedral's thirty-meter height.

He turned his attention to the front of the cathedral—to the little transparent room from which the sermon would be delivered. The air-filled room was like the congregants, also tethered, and floated about eleven meters from the bottom. Paul saw the room rock as a wizened man moved clumsily inside it—the preacher, no doubt. He was heavyset, even paunchy, but at the same time seemed much too frail to have come down to deliver a sermon. Indeed, the man looked in ill health. Paul was impressed by the preacher's obvious dedication.

He hoped the sermon would be a good one—and might even give him some arguments to convince Ingrid that designer babies weren't a good idea. Yes, he knew the nondenominational service was more public relations than anything else. Still, against the background of this sunken cathedral, a powerful message might well be delivered.

This year's conference was subtitled "Genetic Engineering in a World of Water." The organizers had arranged the underwater service in an attempt to convince the religious lay public that geneticists weren't godless monsters. And polls indicated that what with the super-dolphin fiasco, those religionists who seemed to set the national agenda needed a lot of convincing.

Navy scientists had genetically engineered dolphins for high intelligence, neatly bypassing a half million or so years of evolution. They wanted smart bombs, bombs they could talk to, smart dolphins carrying explosives. The engineered super-dolphins quickly proved they were indeed intelligent; they might or might not have been sentient, but apparently they understood the Navy's intentions—and wanted no part of it. They escaped their enclosure and fled to the open seas. Subsequently the Navy dropped the project.

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That was years ago but now, just weeks before the Genetics Conference, researchers found that virtually all dolphins in the wild were super-dolphins. They, the Cro-Magnon of dolphins, had replaced the Neanderthal of dolphins. And what with the waters diminishing the land, people were growing afraid—especially of those soulless intelligences from the oceans.

Paul glided in next to Ingrid, snapped into the adjacent tether, and exchanged some signed intimacies with his wife. He glanced around at the other attendees and then at the cathedral itself. It was impressive, even under water—especially under water. The nave, a vast gothic cave with massive columns supporting soaring arches, had a look of the infinite, the blue tint from the water making the stonework appear ethereal. The stained glass in the circular rose window added diffuse reds and yellows against the blue and stood like a large but complex and subdued sun. The religious images and statues gave a feeling of an eternal lost world. To the right, the south transept faded to a mysterious darkness while to the left, the open arch exposed the crumbled remains of the north transept and the open sea beyond—distant coral reefs with schools of fish; congregations of fish, eels, mantas, and bottom-dwelling crustaceans.

Paul experienced a twinge of conscience, regretting that he'd not attended services nearly as often as his religion required. Thinking about it, he had to admit to himself that he was more of a devout researcher than a devout Christian.

Paul glanced at his dive computer. It would be a short sermon, as at this depth, a dive of more than a half hour would be pushing it.

Waiting for the service to start in the silence broken only by the breathing noises from his regulator, he examined the mechanics of the event. The transparent room had an open circular hole in the floor, the only method of entrance. The minister had to have come in that way. Visualizing that, Paul was more impressed than ever with the guy. The man must be a true believer.

There was a pulpit in the room, a lectern really, and next to it, a table. On the table were the Voice Recognition, ASL translation monitor, and also a little box, the function of which Paul couldn't discern.

Outside the room, on the left and right sides, were two enormous underwater speaker systems. There would certainly be no problem in hearing what the man said. Next to one of the speakers lay a large cube about a meter on a side. Paul wondered what it did. He speculated that it might be some sort of feedback system for dealing with underwater acoustics. He smiled, remembering from grad school the complexities of hydrodynamics. He pondered how the added complexity of acoustics would effect the equations.

The preacher began speaking, explaining first that he was a substitute; the scheduled minister had been taken suddenly ill. Then he launched his sermon—an old-fashioned, fire-and-brimstone condemnation of the times. Paul tried to pay attention, but his mind was occupied with acoustics equations. Only snippets of the sermon registered. "The Earth has turned against us." Paul speculated on the hall-dynamics of an underwater auditorium. "The land is a blemish." Or what about an auditorium filled with helium? "A temporary, earth-lined hole in the ocean." Or maybe filled with molasses. "This is the second flood. And after it will be the second coming." Paul continued visualizing equations, but when the preacher shouted that genetic engineering was an affront to God the creator, he jolted to attention. Looking around, he could see that the other listeners seemed stunned. This sermon was not exactly what one would expect with a congregation of geneticists.

Ingrid tapped his knee and he looked at her. "Something's wrong," she signed.

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"It certainly is," Paul signed. "He's a jerk. The guy's father probably had him genetically engineered to be a high-school football player."

"No," Ingrid signed. "I mean I think I saw him mouth 'Glory to God, my commander.'"

"What? It can't be!" Paul furrowed his brow. Something *was* wrong. That was the motto of the Guardians of the Light, one of the many radical Christian fundamentalist groups that had sprung up lately. He looked over at the preacher—at his build, the way he carried himself, the close-cropped gray hair. It fit the description of Ezekiel Bushman—the reclusive fundamentalist organizer who'd never allowed himself to be photographed close up. *I thought he was dead.* He'd been the commandant of the Guardians—that is, until he'd come down with an inoperable tumor. *I wonder what he's doing here.* Paul took a deep breath and released it. A long stream of bubbles rose from his breathing regulator. *Probably the man wants to go out with a bang.*

Paul tensed. He knew what was going on—not from physics, not from analysis, but from pure, certain instinct. And he knew the purpose of the cube.

"What's the matter?" Ingrid signed.

"I . . ." Paul stopped to analyze. *Why would they bomb a religious observance?* The answer was obvious. *They've always equated nondenominational with Satanic, and they absolutely despise geneticists.*

"I think," Paul signed, "we may be in big trouble." He hand-spelled the name Ezekiel Bushman.

Paul nodded toward the cube and Ingrid followed his gaze. "A bomb?" she signed, fear showing even through her mask.

"I think so."

"No, it can't be."

Paul saw more bubbles than usual rising from Ingrid's regulator. "Keep calm," he signed.

"What can we do?"

Paul paused. "We could leave . . . but . . ."

"I know. I couldn't live with myself if we left and the others died in a bomb blast."

Paul nodded.

"What do we do?"

"Let me think."

"Hurry," Ingrid signed. "We might not have much time."

"I know." Paul analyzed the options. He couldn't alert the security people. And anyway, there wasn't anything they could do. At the first hint of trouble, the preacher would just set off the explosives. Paul narrowed his eyes in concentration and prayed for it to be a long sermon. He glanced at his elapsed-time dial; it wouldn't be all that long.

Paul sighed through his breathing regulator. He could think of only one possibility.

He unclipped his tether and pushed down with his flippers, sending him gliding upward. "I love you," he signed, looking at Ingrid. "Trust me."

With arms extended upward, he gazed heavenward, trying to look as if he were in the throes of religious ecstasy. He'd had a fair amount of experience expressing emotion using body language—it was important in ASL.

Stealing a glance at the preacher, Paul saw he was having an effect. The man still ranted, but he did so mechanically, his eyes locked on Paul.

Paul made a thumbs-up sign and then put his hands together as if in prayer—one hand open, the other balled into a fist, the salute of the Guardians of the Light. The preacher stopped in midsentence. Paul, trying to imagine how he'd behave if he'd just learned that the person watching him was the Messiah, extended his arms to the preacher, then crossed his arms over his heart and lowered his head. Then he made the praying fist sign once more. He bent his knees as if kneeling in prayer and made gestures he hoped would be interpreted as a desire to come into the booth to pay homage. From the corners of his eyes,

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Mark observed the security officers; they were watching him but had not made any moves to intercept him. *So far, so good.*

The preacher looked at first confused, then proud.

Paul, still with his feet bent as if he were on his knees, stroked softly toward the booth. He knew that to the geneticists, he must look ridiculous—like a sea horse. In front of the transparent booth, Paul bowed his head, made the praying fist sign, and then pointed to the circular entry hole and looked imploringly up at the preacher.

The man stared at him for a few seconds, and then nodded.

Paul swam to the entry and climbed up into the booth. He got to his feet, let his mouthpiece fall away, and stripped off his mask. He took a few breaths; it was a pleasure breathing through his nose again. Then, uncertain what exactly to do next, he again made the praying fist sign.

"Tell me, son," said the preacher, "what's a Guardian doing here among these infidels?"

Paul glanced heavenward, asked forgiveness ahead of the act, and double forgiveness if indeed he'd made a mistake—and then hauled off and slugged the preacher.

The man dropped like a brick to the floor.

Looking out the transparent front wall, Paul saw two security officers swimming like sharks toward the booth. Ingrid followed close behind them. Paul grabbed the microphone. "Ladies and Gentlemen," he said, "I'm sorry about the violence, but I've reason to believe . . ." He grimaced, for actually, he had no real reason at all.

Looking away at the table, he saw, close up, the little box next to the ASL monitor. It had a button and a key. It could well be a detonation device. Perhaps, he *did* have reason to believe.

Paul explained as best he could to the assembly, and suggested everyone return to the surface, return to land, for an early lunch before the afternoon sessions. When he'd finished, he turned to the security officer who'd just clambered in from the entry hole. Ingrid climbed in just behind him.

The security officer whipped off his mask and Paul saw that the man's face was not skin, but short fur—a not particularly uncommon genetic modification. His parents must have liked dogs. In fact, the man's appearance was not at all unattractive.

Trying not to smile at the thought, "police dog," Paul pointed to the box.

"Yeah, it is a detonator, all right," said the security officer, examining the object without touching it.

Paul, standing behind, glanced at Ingrid and signed, "You will, I hope, explain to your colleagues, that your husband is not some sort of Christian fundamentalist?"

"Aren't you?"

"Armed and set," said the officer.

"What do you mean?" Paul signed. "Is this about children?"

The officer turned the key to the off position and then removed the key. "It's okay now."

"Yes," Ingrid signed.

"Probably now isn't the best time to talk about it."

"All right." The officer straightened from his concentration on the box. "You can leave it to me now. It would probably be best if you left and joined the others at lunch." He seemed aware now of Ingrid's signing and the deafness it implied.

"Good," said Paul. "We'll do that."

"We'll have to talk about it soon—or never," Ingrid signed. "The biological clock is ticking."

"These Christian fundamentalists," said the officer. "Every day, they're getting more fanatical."

"Agreed," Paul signed, nodding simultaneously to the officer and to Ingrid. "Let's talk about it after lunch."

"It's good you spotted this," said the

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officer. "You've probably saved a lot of lives." He threw a glance upward. "In a boat, you wouldn't scarcely have felt it, but down here, phew."

"Fine," Ingrid signed.

The officer pointed at the ASL monitor. "We should have just turned this thing around so your wife could see it. You wouldn't have had to translate our conversation."

Paul smiled.

Paul climbed the sea-ladder and flopped into the houseboat. Quickly he stripped off his mask and regulator, and then turned to help Ingrid aboard.

"Instead of going back to the conference," Paul signed, "Why don't we sail the other way? We can eat on board. I think we need to talk." He took a deep breath; it felt great inhaling the sweet, fresh air and feeling the warmth of the sun.

He held her while they both gazed at the nearly unblemished sea; except for a security launch and the frigate, the other boats lay in the distance, well on their way to shore.

"I know you want children," Ingrid signed.

Paul nodded.

"Then let's see if we can settle this today," Ingrid signed. "After lunch, let's confront this—underwater—and naked."

"Yes, good." They often dived bare, either when feeling naughty or when they needed to have a very honest conversation. And Paul knew Ingrid wanted this particular discussion to be held underwater so she didn't feel at a psychological disadvantage because, on land, her deafness was a disability.

"Thank you." She disentangled herself and, before heading into the cabin, signed, "I'll prepare lunch."

While sunbathing on their boat some hour or so later, Paul observed the steeple through binoculars. It stood about midway between their boat and land. The frigate had drawn close and Paul saw what looked like a robot submersible hoisted from its deck and lowered into the sea.

"Bomb disposal robot, probably," said Paul, relying on Ingrid's lip-reading since his hands were occupied with the field glasses. "They certainly came prepared."

An hour after that, Ingrid pointed out a swell spreading out over the usually glass-smooth surface.

"I guess they towed the bomb away and detonated it," Paul signed.

Ingrid shook her head. "The poor fish."

In the distance some seconds later, Paul saw lifeless fish float to the surface.

Several hours later they saw the frigate retreat, leaving the sun-bleached white steeple looking stark and incongruous against the featureless blue surrounding it. More by tacit agreement than premeditation, Paul piloted the houseboat back to the spire. By the time they reached it, their dive computers indicated that most of their previous dive's nitrogen had diffused out of their bloodstreams; it was safe for them to dive again.

"I think we should have our chat now," signed Ingrid.

"Yes."

"Let's go back to the cathedral."

Paul smiled. "I thought you were a nonbeliever."

"I still am."

They geared up, sat on the railing and backflipped into the water. Down they swam to the cathedral, approaching it from the front from where it looked like the bastions of some timeless underwater archdiocese. There, with no undersea current, they let themselves glide, using their flippers only to counteract their slight negative buoyancy, rising slightly on the inhale and sinking again as they breathed out. They swam side by side, but with a separation sufficient to see each other sign.

They danced around the issue of genetically engineered children for a

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while, she for it and he against. Then Ingrid signed, "Sometimes I wonder if we should even bring a child into the world now. With people squeezed ever more together as the waters rise."

"It might not go on." Paul gave a thumbs-up. "At ONR, we're looking at mega-projects like leveling mountains to make dikes and levees. Or it might even be feasible to use thermonuclear undersea explosions to raise up new mountains and give more volume for the oceans. We might lower the water level again."

"Wouldn't that be hard on the fish?"

Paul smiled under his mask. "It's us or them."

"Maybe it should be them."

They drifted under the arc of a flying buttress and Paul felt surrounded by sanctity. "It will be us. Mankind has dominion over the soulless animals."

Ingrid shook her head slowly. She had no need to sign her feelings. She sped forward, passing the archway where the north transept had stood.

As Paul swam to catch up, he happened to look through the arch to the stone altar far below. Now it was afternoon and the sun no longer shone through the rose window. The altar stood in murky darkness. A motion caught his eye and he struggled to see it. As his eyes adapted and the scene registered, he swallowed a gasp. Wondering if he were hallucinating, a victim of nitrogen narcosis, he checked his wrist dive-computer. Everything was fine. There was no way he could be narked out. But down at the pulpit, a dolphin looked out on a congregation of eight or ten other dolphins who lay calmly on the pews.

Catching sight of Ingrid who had swum back to him, he pointed.

Ingrid signed astonishment and shook her head. "They actually seem to be appreciating the art in the place."

"Appreciating art, hell! They're praying, worshiping."

"Soulless dolphins," she signed with exaggerated motions indicating she was mocking him. "No," she gesticulated. "That's ridiculous."

Paul stared at the dolphin at the pulpit. And it seemed the creature stared back. Paul, his eyes locked with the dolphin's for a moment, shivered. The animal looked highly intelligent, even sentient. *But . . . But Ingrid's right. They are just soulless animals.*

The dolphin moved and Paul sensed that the creature was communicating with its body, a kind of signing. The pod of dolphins, moving as one, swam toward the arch, toward him.

Paul and Ingrid began swimming furiously to get out of the way as the creatures streaked toward them. The dolphins ignored them, sped through the arch, zoomed by them, and disappeared in the distance.

"What do you think that was about?" Ingrid signed.

Before Paul could answer, he heard a mechanical-sounding voice coming from one of the underwater speakers. It said, "Explosion imminent. Thirty, twenty-nine, twenty-eight."

By "twenty-seven," Paul comprehended.

"Run," he signed, conscious it was not exactly the appropriate sign.

"Why?"

"Another bomb." Paul pointed up and the two of them raced for the surface, speeding through the bubbles of their breathing. He knew they should pause for a couple of minutes of decompression when they were fifteen feet from the surface, but there was no way—a possible case of decompression sickness was a lot better than being knocked unconscious by the shock wave. He started to calculate the likelihood of the bends but immediately gave up. It was pointless. There was no action he could take based on the results. He wondered why a bomb would announce itself. *There's no understanding the mind of a Guardian—assuming that they're even sentient.*

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Paul got nowhere near the fifteen-foot mark. A great flash reflected through the water and an instant later, he heard the muffled sound of an explosion. A shock wave vortex pounded him, spinning him around, wrenching away his mouthpiece and stunning him. As he began to black out, he looked frantically and without success for Ingrid. Then he felt embarrassed, thinking what people would say when they found their bodies, naked.

Paul inhaled, and breathed in air. He felt a firmness around him as if he were wedged into a crevasse with rubber walls. Opening his eyes, he saw the walls were dolphins; two of the creatures, side by side, had him cradled between their sleek bodies. His memory returned. *Ingrid!* Looking off to the side, he saw his wife swimming beside one of his dolphins. Apparently, she had recovered before he had.

"Are you okay?" she signed awkwardly, her hands being needed both for signing and swimming.

"What?" Paul rubbed his forehead, then shook his head to clear it. "I think so." He sat up and the dolphins parted, depositing him into the water. Seeing that he was in the shadow of their boat, he paddled toward the sea-ladder. He climbed, pausing midway while the dizziness passed. Then, on board, he extended a hand to Ingrid.

"Those dolphins saved our lives," Ingrid signed when she again had free use of her hands.

Paul looked over the railing at the cetaceans, catching the eye of one of them; it seemed to be the pod leader. "Thank you," said Paul, feeling silly and self-conscious. Then, feeling even more ridiculous, he signed his thanks.

The pod leader's movements, its body language, made it seem it understood. The dolphin, its intelligent-looking eyes shining like a cat's, nodded his head, then turned and dived. The other dolphins followed.

* * *

"What happened down there?" Ingrid signed. She and Paul flopped down onto deck chairs.

Paul looked out at the sea littered a second time with dead fish. "A second bomb. A backup with a timer."

"No," Ingrid signed. "I mean, just now."

"The dolphins?" He shrugged. "I don't know. Some reflex behavior, I guess."

"I do so love you—" She made one of the signs she'd created meaning "Paul," the one implying endearment. "—but you can be so dense. Those dolphins showed intelligence—and compassion, maybe even sentience."

Paul was about to give a doctrinal response, but didn't. He was a scientist. He needed to think.

Ingrid seemed to understand. She clasped her hands, a signal that she'd not interrupt his thoughts with ASL. After a couple of minutes though, she leaned forward, touched his arm, and pointed. "Look. The cathedral's spire is gone." She signed sadness. "I'll miss that cathedral."

"Well, if we have a girl," Paul signed, smiling, "we can name her Cathy in memory of it."

"Very amusing."

"I'm serious, sort of. I really do want children, though." He looked off to the sea. "I've been thinking and I've had something of an . . ." Not knowing the ASL for it, he spelled out "epiphany."

Ingrid looked at him, expectantly.

"Those dolphins," he signed. "With their obvious intelligence and the reverence they displayed down in the cathedral . . ."

"Yes?"

"This is very hard for me to say." Paul bit his lower lip, pounded the arm of his chair with a fist, and then signed, "But . . . But I find it impossible to believe they don't have souls."

"Cathedrals are designed to be impressive," Ingrid signed. "Impressive to dolphins as well, I imagine."

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Paul knew Ingrid was trying to give him an honorable way out, but he wasn't going to take it. "I think there's more to it than that." He struggled within himself. "Those dolphins . . . Who but God is entitled to say what creatures he made in his image?"

Ingrid looked at him, quizzically. "Who indeed?"

"Our future is in the sea." Paul knew he was at the fringe of incoherence. "And dolphins are mammals, creatures of both the air and water."

"So you want to make the world safe for dolphins."

"Hear me out."

"Fine. Go ahead."

"A soul could only be given by God."

"Agreed," Ingrid signed, "that is, if there is a god—and there is such a thing as a soul."

Paul smiled wistfully. "Who knows, but at some point I may have to rethink those beliefs as well. But not yet!"

"What are you trying to say?" Ingrid signed with small movements—her indication of empathy.

"These super-dolphins are a product of genetic engineering." Paul paused for a moment, rethinking his analysis before signing it. "And I believe they have souls. So genetic engineering must, at least tacitly, be acceptable to God."

She nodded.

"And this," he went on, "has bearing on our children."

"What are you trying to tell me?"

"I've changed my mind. I agree with you. It will be fine if we engineer our kids for beauty and intelligence. And now that the genetics is understood, even with cats' eyes if you'd like." He looked at her, lovingly. "And your eyes are truly beautiful."

She hugged him, then backed up to sign. "It's funny. I was looking for a good time to tell you I just want children. It's not that important that they be engineered. We can have them the natural way if you prefer it."

"No. I won't be an anachronism in the world. I'm okay with genetic engineering now." He smiled. "I think I'll draw the line though, against engineering our child to have big feet, webbed toes, and gills—at least not our first child." ■

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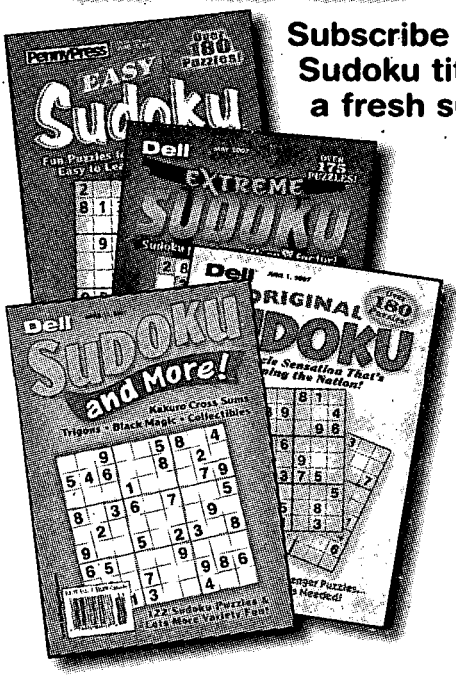

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Conversations with My Knees

Ron Goulart

What do you mean, you don't believe the title means what it says?

The side effects of my knee replacement procedure were not what I'd expected. They included the termination of my marriage to a once nationally popular folksinger, a fling with a redheaded young woman I'd initially thought was just a night nurse, the intrusion into my life of spies and secret agents of several nations, and my conversion, at the age of sixty-one, into what I can only describe as some sort of superhero.

My knees started talking to me the second day I was back home in my Marin County home after my stay at the Slesinger Foundation Clinic over in San Rafael. I was sitting in our beam-ceilinged living room, looking down toward San Francisco Bay far below. As usual, there were quite a few bright sailboats wandering around down there. My wife had propped two fat paisley pillows behind my back and draped a Navajo rug over the lower part of me before driving to a rehearsal studio in Sausalito.

You've probably heard of her. Mavis Scattergood. Until about seven years ago she and two fellows were the Scattergood Singers, very successful singers of liberal folk tunes who came damn close to winning a Grammy. Mavis had recently rounded up two new fellows and was hoping to revive the Scattergood Singers. Only snag was Edmond Scully, the new banjo player, who felt the group should be called Edmond, Fred and Mavis. My name, by the way, is Frank Whitney, and I'm a retired advertising agency art director.

"Don't worry about falling down while you're home alone, dear," said a motherly voice.

Though I had the impression the voice was coming from the vicinity of my left knee, I glanced around the big sunlit room. There was nobody to be seen.

"Imagine your wife abandoning you, and you only two days out of surgery."

Leaning forward on our tangerine-col-

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ored sofa, I tugged off the red, gold, and yellow blanket so I could scrutinize my knees.

"What you really ought to be worrying about, pal," said my right knee through my wrinkled denim slacks, "is what your dumpy missus is really doing in Sausalito with Edmond and Fred. Especially Edmond, who's a real stud but, truth to tell, a lousy banjo picker."

The motherly voice of my other knee said, "Now don't get poor Frank all riled up. A wayward wife isn't the major problem he has to—"

"Pardon me," I put in, reaching toward the blond coffee table for my cell phone. "I'd best call the Slesinger to report these hallucinations."

"Relax, dimbulb," advised my right knee. "You ain't goofy. What they implanted, unbeknownst to you, chum, are some very state-of-the-art artificial knees. Or rather not *they* but Dr. Wallace Dowling."

"Dowling?" I frowned, putting the phone down. "He's not my physician."

"Were you awake during the operation, pal?"

"Well, no, but—"

"Dowling took over after you shuffled off to dreamland."

"Dr. Dowling is a very nice man," said my left knee. "We're starting to get very worried about—"

"Button your yap, sister. We'll get to that in—"

"Wait now," I said, frowning. "They mentioned Dowling on *Wake Up, Marin* this morning, didn't they?" It hadn't taken me long to get used to my unusual knees. Here I was having a conversation with them already.

"That they did, kiddo. The doc vanished last night, did a bunk, vamoosed."

"Come now, the poor man was obviously abducted."

I cleared my throat. "It's too bad about Dr. Dowling," I admitted. "However, I'm much more interested in why my replacement knees can talk. There sure as hell wasn't anything about that in the brochure they—"

"All in good time," my motherly knee told me. "First, young man, let us tell you about the favor we want you to do for us."

"He ain't a young man," corrected my other knee. "Sixty-one puts him in the old fart category. All you got to do is take a gander at his puss to realize—"

"How can you look at me?" I wanted to know. "Knees don't have the power of vision."

"We're using *your* eyes, dopey. When you looked in the bathroom mirror this morning, we took a gander," explained my knee. "Got a look at your missus, too. Jeez, is she going to seed. Only forty-nine, too. She's going to be a real blimp by the time she's your age."

"Now, now, Mavis is still a very attractive woman. And she has a truly lovely voice."

"Oh yeah? How come this broad hasn't had a singing gig in six years?"

I again requested, "Tell me why my new knees can talk."

"Simple. Dowling used you as a guinea pig, sappo. He wanted to test us out—and we're a lot more than knees, by the way—before installing his gadgets in somebody important."

I shot to my feet and began to pace the big room. "No, before I call the clinic, I'm going to get in touch with my attorney. And maybe the AMA." I went striding over to one of the big view windows to gaze out at the glaring afternoon.

"Notice anything, dude?"

"Hum?"

"You walk pretty good for a gink just out of surgery."

I inhaled sharply, stared down at my feet. "Yeah, now that you mention it, how come I—"

At that point I began to tap dance. I circled the living room, doing a pretty fair impression of Fred Astaire. Then I completed a brief but complex Irish jig, added a few very convincing Flamenco stomps, and settled down in one of our

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faux Morris chairs. "Christ," I observed. "How in the hell can I—"

"First," cut in my right knee, "ask not what your knees can do for you, chum, but what you can do for us."

I overcame the impulse to stand up again. I didn't want to risk dancing around the room anymore. "Do for my knees?"

The motherly one said, "All we'd like you to do is help us find Dr. Dowling."

"I'm not much of a cook," I said.

"You are now," my right knee assured me.

My knees and I were standing in our large redwood and copper kitchen. Dusk was settling in outside.

"You need some good warm food inside you, dear boy," said my other knee. "A meat loaf sandwich indeed."

"Soyloaf on twelve-grain gluten-free bread," I corrected.

Mavis had called a few minutes earlier to say the New Scattergood Singers' rehearsal was running late. She wouldn't be home in time for dinner, but she'd left a substantial sandwich for me in the refrigerator.

"Late rehearsal, my fanny," commented my right knee. "It's shack-up time in the old corral if—"

"You don't have a fanny," I pointed out as I found myself trotting out into the kitchen.

"Figure of speech."

Now I was standing in front of our state-of-the-art turquoise-colored stove. "These new knees—you guys, that is—you can convert me into a gourmet chef? What the hell does Dr. Dowling have in mind?"

"His initial assignment from the National Office of Clandestine—"

"No need to blab too much, sis."

"Well, the poor man has to know what's happened to him."

"Okay, but I'll give him the skinny. Dowling is an expert on advanced robotics and performance-enhancing implants."

"Why would a guy with those qualifications be working at the Slesinger?" I noticed that I had walked over to the fridge and was taking out a carton of eggs and a handful of portabella mushrooms.

"Some parsley, too," suggested my maternal knee.

The other knee continued, "Doc Dowling has a little lab hidden down in the bowels of the joint. He's developed a device that can convert an average gink like you into a crackerjack fighting man. Once inserted it can—"

"Why does a crackerjack fighting man need to tap dance or concoct omelets?" I was beating an assortment of omelet ingredients in one of our earth-color mixing bowls.

The maternal knee explained, "Dr. Dowling, bless him, believes that even a brutal fighting man should be well-rounded. You'll find that now that his secret serum is coursing through your veins you—"

"Secret serum." I stopped whisking, and goosebumps visited both my arms.

"You will be a wiz at math, including advanced calculus, speak six additional languages, including Mandarin Chinese and—"

"You won't have any further trouble getting it up," added my other knee. "Bothersome erectile dysfunction is a thing of the past."

"Hey, I don't have any problems with that."

"Haven't had much opportunity to test that premise of late, have you, dude?"

"Well, no, but—"

"Let's get on with fixing dinner. A nice salad will fit in perfectly with our omelet."

As I gathered the ingredients for a small salad out of the crispers, I asked, "Why did Dowling put his gadget in artificial knees?"

"He only did that in your case. Usually, chum, the enhancer, housed in two very compact units, will be installed in

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one of the buttocks."

"And why test it on me?"

"Dowling wanted to run a few human tests right now, but the higher ups nixed that. They didn't think the enhancer was quite ready yet. So the doc decided to try it out on his own."

"But why me? I'm too old to be a fighting man."

"Exactly, buddy. If he can convert an old wreck like you into a first-rate warrior, then the enhancer will work on anybody. That means that a lot of young wrecks can be turned into gung-ho soldiers come the next big one."

I was crumbling feta cheese into my salad dressing. "How come the doctor didn't ask my permission? And was he planning to let me know eventually about his illegal experiment?"

"Of course he was, dear boy. Unfortunately, he vanished."

"Bright and early *mañana,* kiddo, we'll start hunting for him. You can't trust the FBI to track him down, nor the . . . Oops!"

I set down the bottle of olive oil I'd picked up. "What?"

"Visitors. Let me handle this, jocko."

"How can a knee—"

The door chimes sounded.

Two tall men in dark suits were standing on our twilight doorstep. Both had close-cropped blond hair and were in their early thirties.

The leaner of the pair inquired, politely, "Are you Mr. Frank Whitney?"

"Yeah, and who might—"

"I'm Agent Mickens with the National Counterspy Bureau." He showed me a plastic ID card with a holographic portrait of him included. As he tilted it toward me his image took on a third dimension. "And this is Agent Tubridy, also with the NCB."

When Tubridy, the bulkier one, tilted his ID, the portrait remained two-dimensional.

I was about to suggest they come into the living room, when I found myself saying, "Nice try, buster, but no cheroot. That ID of yours is as phony as a three-buck bill. It lacks the spread eagle and the Colonial flag images that are supposed to appear behind your portrait."

"Sir, I assure you that—"

"Looks to me, buddy boy," I informed him, "like you're actually in the employ of some second-rate, low-budget Middle European nation with delusions of grandeur."

"In that case," said the apparently spurious Mickens, "grab the bastard, Bruno."

The faux Tubridy leaped across our threshold, grabbing me in a very impressive bear hug.

To my surprise, I kneed the big man in the groin, which caused him to let go. I then grabbed his arm, applied some sort of martial arts grip, and tossed him halfway across the room.

Bruno landed, hard, on Mavis' Early American rocking chair.

The whole damn chair, which I've never much liked, collapsed under him.

Discouraged, he got to his feet to go running across the living room. He slid open the wide glass door to the deck and dived outside into the approaching night.

Following, I tackled the big fake agent.

He fell with a substantial *thunk,* twisted free, and grabbed up Mavis's large potted cactus.

I avoided his attempt to conk me with the heavy orange pot, jabbed him in the midsection. He yowled, toppled back against the deck railing. Along with the potted cactus, he went falling down to the shaggy slanting hillside some ten feet below.

The pot shattered, sending orange shards into the new night, and the cactus shot up a few feet and then bounced on Bruno's crewcut head. He got, shakily, to his feet to go running, shakily, away into the night.

I spun around, ready to face the fake agent Mickens.

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My front door stood open, the living room was empty.

"Damn it all," commented my right knee, "you let both of those bozos get clean away."

"Now, now. He did pretty well, considering he's just getting used to being a crackerjack fighting man."

"Yeah, I suppose so, sis. And, hell, they'll be more spies and secret agents dropping in from now on. Sure, we can question *them*."

"More?" I asked.

It was around about midnight that I found out about another batch of my new abilities. Since coming home from the clinic I'd been sleeping in the spare bedroom. Mavis had complained, as she was driving me home from the Slesinger, that my new knees made funny squeaking noises that might keep her awake, especially if I tossed and turned as I usually did at night. "That's disturbing enough," she pointed out, "without adding metallic sound effects."

At about ten o'clock that fateful night Mavis was fluffing the pillows on the narrow bed I was temporarily occupying. "You've got to use that cane I bought you, Frank," she said as she bent to kiss me on the cheek. "We can't have any more accidents like this afternoon. You could have been seriously hurt. Not to mention that the chair cost $500."

I hadn't yet told my wife about my new knees or the visit from the spurious American intelligence agents. I had said I stumbled and fell over the rocker. "Won't happen again, dear."

"And do be more careful when you go hobbling out onto the deck," she continued. "This time only a potted cactus fell downhill, and it only cost $129, but if *you* had fallen—

"I know, I'm worth at least three times that."

"Seriously, Frank." Mavis pointed at the cocoa mug on my temporary nightstand. "Drink the hot chocolate I fixed for you. It will help you sleep."

I didn't believe that after my stimulating last few hours I'd be able to do much in the way of sleeping. But I picked the cup up, took a sip. Then I grimaced. "Not especially sweet."

"We're watching our intake of sugar, remember. Now drink up."

I drank up and set the mug back on the table. Surprisingly, I was feeling drowsy already. As my wife tiptoed out of the room and quietly shut the door of the bedroom, I sank back and commenced slumbering.

"Rise and shine, chum. Off your ox and grab your sox."

I jerked up into a sitting position. "Hum?"

"How are you feeling, dear boy?"

"I'm okay. Did you wake me up just to—"

"Shake a leg," suggested my right knee. "The game's afoot."

"What game?" I swung out of bed, feeling completely awake. "Funny, I don't feel at all sleepy, but before—"

"That's because we've counteracted the sleeping potion your fat folknik wife slipped into your hot toddy, dumbo."

"She's a bit plump, but not—"

"Fat or skinny, dude, what you ought to wonder about is *why* she doped you."

"If she actually did." I was pulling on a pair of dark blue jeans.

My left knee asked, "Who can you trust if you can't trust your own knees, dear boy?"

"Socks and shoes and hurry up," said my other knee. "She's already pulling out of the driveway."

I continued dressing. "Who?"

"Your missus, the sweet singer of Sausalito, the distaff Pete Seeger."

I glanced over at the alarm clock on the nightstand. "Were would Mavis be going at midnight?

"To meet one third of the Scattergood Singers."

Fully clothed, I now had a desire to leave the spare bedroom. "I thought you

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were interested in locating the missing Dr. Dowling. What's Edmond Scully—I assume it's him you're alluding to—got to do with that?"

"All in good time," said my maternal knee. "Now put on a warm coat, the night's turned a bit chilly."

I took my fleece-lined car coat out of the hall closet. "Hey, how am I going to follow Mavis? We only have one car, the Toyota, and she took that, according to you."

"On foot, dopey."

"Then let's hope she's not going far."

"Sausalito."

"Sausalito? Christ, that's at least fifteen miles from here."

Walking down stairs, my right knee said, "Told you he was still dense, in spite of all the improvements we've made."

"Not dense, just a mite slow on the uptake."

"What are you implying? That I've turned into some sort of Six Million Dollar Man?"

"Wasn't that obvious after this afternoon, buddy?"

"I suppose so, but—"

"Less gab, more action."

I stepped out into the night.

"Slow down a little, dude," cautioned my right knee, "or you'll overtake her."

"Don't be so critical," said my other knee. "After all, this is his maiden run."

I slowed my pace. "This is neat. I've been running for over fifteen minutes and I'm not even winded. And I'm covering a mile or so every minute. That's beating every record."

"Quit bragging, Speedy. Concentrate on our mission."

Mavis was taking a roundabout route to Sausalito, avoiding main roads. Following our red Toyota, I'd been running, with ease, along quirky back roads and along narrow, tree-lined lanes.

My eyesight had greatly improved, too. I could see the rear lights and our license plates from a quarter mile behind. People do jog by night in Marin County and I slowed to a normal pace when an infrequent car approached, so I didn't attract undue attention. Although one Volvo driver yelled, "Carry a flashlight, asshole!" as he passed me going in the other direction. A belligerent German Shepherd chased me for a couple minutes, but I easily outran him.

"Destination coming up," announced my right knee.

We had reached the outskirts of Sausalito, up in the hills above the bay. Downhill Mavis was signaling for a right turn. Taillight blinking, she eased off the road into the small parking lot next to a small club called The Lethal Injection.

I shifted down to a slow trot, then stopped behind a stand of eucalyptus trees at the lot edge. "How'd you know Mavis was heading here?" I asked in a whisper.

"Eavesdropping while you were snoozing, chum."

"How could you do—"

"Your hearing is enhanced, dear boy."

"We can hunker down here and listen in our your spouse's midnight rendezvous inside."

"I don't hear anything but crickets."

"You have to concentrate. We'll help you get going and show you how to zero in on her and the lad who's cuckolding you."

"Even if that's true, which I doubt, what in the hell does it have to do with Dr. Dowling and—"

"Listen, dude."

"... first garage band to fuse hip-hop, bebop, and retro rockabilly," I heard an MC saying. "Here are the Defrocked Priests for their final set at Lethal Injection."

"Yow," I remarked as very loud electric music came flooding into my head.

"It'll take another minute to locate Mavis and filter out the surrounding noise."

"... hip hop shabam always reminds me of you," sang someone through his nose.

"... but how did they know we were

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sleeping together, Edmond?"

"They're *spies,* flowerbabe," said Edmond. "They know how to find out stuff."

"This gink calls your wife flowerbabe?"

"So it seems."

"A rather catchy sobriquet."

"Hush, sis, so we can monitor this gabfest."

"You were the one who first intruded."

"Button your yap."

". . . can't believe anyone would think Frank is important," Mavis was saying to her banjo player.

"They'll pay us $20,000 to lure your useless husband to their lab."

"That would certainly help finance the comeback of the Scattergood Singers, but—"

"Edmond, Fred and Mavis," Edmond corrected.

"Still," continued my wife, "I don't understand how they can remove Frank's knees without hurting him. Admittedly he's not much of a hubby, but it will bother me if he's going to bleed all over the place."

"Look, Mavis, they've got this Dr. Dowling stored away in their clandestine laboratory," he pointed out. "The guy ought to be able to perform a simple goddamn knee operation."

"But then Frank won't have any knees."

"Don't be obtuse, hon. They'll obviously force him to replace the knees with new ones." His voice was sounding a bit impatient. "These spies sounded pretty humane to me."

"You haven't mentioned what country they represent."

"The United Kingdom, I think."

"Aren't you sure?"

"Well, the three of them are very polite and well behaved. They wear tweedy clothes and have BBC accents," Edmond explained. "I'd say they're Brits, though they haven't openly declared that."

"Britain is an ally of the United States, sort of. So it's not like selling Frank's knees to, say, oh, China or Cuba."

"Course not. And we can sure use $20,000."

"Be nice if the price were a bit—"

"I'm meeting one of them tomorrow afternoon to set up the details of delivering Frank. I can suggest $25,000 would suit us better."

"Ask for $30,000. After all he's *my* husband." Mavis' voice faded out.

The Defrocked Priests came back. "Enough," I said and all sound from within the club ceased.

I heard crickets again, then a young woman being sick in the parking lot.

The note was affixed to the surface of the fridge with a Bob Dylan magnet. *Must make unexpected trip to San Fran. To see publicist, dear. Since you're still incapable of driving, you won't mind my taking car. Frozen waffles in freezer. Don't use too much maple syrup because we're watching our sweets intake. Love, M.*

"Lot of hooey," remarked my right knee. "She took off for a roll in the hay with the banjo virtuoso."

"Frozen waffles indeed," said my other knee. "Let's whip up a batch of flapjacks."

"I'm not especially hungry."

"It's wisest, dear boy, to begin the day with a hearty breakfast."

"Okay, okay." I fetched a carton of buttermilk out of the refrigerator.

The Brazilian secret agents, two of them, arrived as I was setting my plate of syrup-drenched pancakes out on the deck table.

They'd apparently tossed grappling hooks up from below and come climbing up thick plastic ropes.

"Bom dia, senhor," said the first one, "we're here to inquire after your *joelhos."*

"Your knees," translated the second one.

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"Oh, I'm doing just fine, better, actually, than I expected." I remained on my feet, smiling blandly. "Certainly nice of you guys to climb all the way up here to ask about—"

"Roll up your pants above the knee," ordered my right knee.

I obliged, far from certain why I was.

"What's this *tolo* up to?" the other intruder asked of his partner.

"Now, dear boy, aim your left knee at the nearest Brazilian. We'll do the rest."

"I see our cover story about being nothing more than concerned neighbors isn't going to work, *senhor,*" said the farthest agent as he reached inside his blue blazer.

Before I could lift my foot high enough above the redwood deck to aim at my target, the pant leg unrolled and covered the knee again.

"Nitwit," remarked my other knee. "The dang ultrasonic beam won't work if the knee is covered.

"How the hell am I supposed to know that?" I reached down to tug up the trouser leg again. "If you would be a shade more confiding, then we—"

"Senhor," said the Brazilian who was now pointing a .38 revolver at me, "we would very much like you to accompany us to our laboratory, *se faz favor,* so that we can extract your knees and return to Rio with—"

"Aim your damn knee, dude."

The second South American agent had produced a .45 automatic. He, too, was pointing his gun at me. "We would prefer to perform that operation there, but we are prepared to do the job, albeit in a cruder fashion, right here."

"Drop your weapons," suggested someone up on my slanting red tile roof.

I looked up to see a slim, red-haired woman of about thirty-five, clad in a crisp nurse's uniform, standing there with a .38 revolver in each hand. "Nurse Munson," I said loudly, "what are you doing on my roof?"

Ginger Munson had been my night nurse during my recent stay at the Slesinger Clinic.

Just then, as one of the Brazilians was aiming his gun at Nurse Munson, my knee went off. A thin line of blurred air shot out at the nearest agent. It struck him in the middle of his chest, then vanished.

"Inferno!" He remarked as he fell over onto the deck, bumping against the table and upsetting my plate of syrupy pancakes.

While this was occurring, Ginger had jumped down off the roof to tackle the other Brazilian intruder.

He was now lying face down, unconscious, and she was handcuffing his hands behind his back. "These fellows are from Brazil's *Agência Muito Secreta,"* she said as she stood clear of the sprawled man. "This one is Antonio Bulcão."

"Apparently you're more than a night nurse."

"I'm with the National Counterspy Bureau. I've been working undercover at—"

"The last person who claimed to be with the NCB," I cut in as I gathered up the fallen flapjacks, "turned out to be a phony and so—"

"Nix," warned my right knee. "This cookie is legit."

"You made a darn favorable impression on me at the clinic, Mr. Whitney," said the government agent. "So I'm assuming you'll cooperate and return to the clinic and, you know, voluntarily return those knees so that—"

"Whoa, honey," said my knee. "How come it took you so dang long to get here? If we hadn't been on duty, a stewpot of spies and secret agents might've hauled this poor sap off to—"

"Now, now," said my other knee, "I'm sure this sweet young lady has a perfectly acceptable explanation. And there's no reason to refer to poor Frank as a sap, now that he's been converted into a—"

"I was reassigned to collect Mr. Whitney after, well, my partner and I didn't succeed in locating Dr. Dowling."

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"Was your partner working undercover at the Slesinger, too?" I asked her.

"Yes, she's Hazel LaMond, but we really must—"

"Huh, the nurse who gave me backrubs."

"We really must be going," Ginger told me. "I do hope you'll come along without too much fuss."

I said, "Suppose you found Dowling and brought him back, Nurse Munson? Do they give bonuses in the NCB?"

She took a step back from me, staring into my face and frowning. "Do you have some idea where he might be?"

"Sister," said my knee, "if you tag along with us, we'll lead you right to him. How about it?"

Midway across the Golden Gate Bridge fog closed in around Ginger's SUV. "Going to make it harder to follow them," I remarked.

Ginger, wearing dark jeans and a black pullover, was driving. "We know where they're going."

"Use your noggin," added my right knee. "We have the ability to track your cheatin' wife and her banjo beau because of the many technological gadgets built into—"

"The dear boy hasn't quite gotten used to being superhuman," my other knee reminded.

"I wouldn't call myself superhuman."

"Don't be so modest, dear boy."

Ginger asked, "Do they always go on like this?"

"Pretty much."

"Hush until we get across the bridge," the redheaded NCB agent suggested.

It was just about three thirty in the afternoon when we reached fogbound San Francisco. Earlier we'd staked out Edmond's cottage in Sausalito. Using my recently acquired eavesdropping abilities, I overheard the phone call from one of the UK agents. He'd invited Edmond to rendezvous with him at their hideaway across the bay in San Francisco to go over plans for luring me into their clutches. Since my wife was with the banjo player and not consulting with her publicist, she was allowed to tag along.

The British agents were operating out of a two-story Victorian house in Presidio Heights. As Ginger drove by the Britishers' lair, I spotted my Toyota sitting in front of the narrow, lemon-yellow house.

We parked the SUV just around the corner on Laurel Street.

"Let's tune in on the Brits," said my right knee.

Ginger said, "I brought my own surveillance equipment, a sound gun and—"

"I'll broadcast through my knee," I found myself saying. "We can both hear."

"Cease babbling," suggested my knee.

"... sorry, old man, but $25,000 is absolutely the most we can offer. These are tough times in the UK and hence we—"

"But Mavis is betraying her husband," Edmond pointed out. "That ought to be worth at least $30,000."

"Look here, old chap," a second British voice said, "we can simply go over to the lady's house, cosh the bloke on the head, and drag him over here to our hidden lab.

"However, we have a reputation for subtlety and we also rather enjoy luring someone into our web."

"As opposed to overt violence."

Mavis said, "All right, okay. We'll take the $25,000. I don't want to have poor Frank suffer any more physical injury than is absolutely necessary."

Sighing, Ginger gave my arm a sympathetic pat.

A British agent, the one with the more nasal voice, said, "What say we now discuss ways and means to get this Whitney cove to trot into our trap of his own free will?"

"Well, flowerbabe and I have been thinking that maybe—"

"I say, who in blazes is—"

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The broadcast abruptly ceased. I inquired, "Why'd you—"

"Out your window, dude."

I turned to see a slim young fellow in a blue blazer leaning toward my window, a snub nose .32 in his hand. I opened the window. "Something?"

"By Jove, this *is* a blooming bit of luck," he said, pointing the gun directly at my head. "Rather ironic as well, I must say. While you've been eavesdropping on us, I've been concealed in yonder shrubs using my sound gun to—"

"I'm with the NCB," Ginger told him. "I'd advise you to put down your weapon and lead us to Dr. Dowling."

"Hard cheese," replied the agent. "What's actually going to happen, madam, is that you're going to turn this Whitney chap over to—"

"Look into my eyes," I found myself telling him.

"Really, old man, this is hardly the time or place for a flirtation."

"Look deeply into my eyes," I suggested. "You are growing drowsy. Soon, quite soon, you'll be nodding off."

"I say, I do feel a mite sleepy now that you mention it." His eyelids were fluttering, his gun hand dropped to his side.

"I didn't know I could hypnotize people," I said.

My right knee addressed the hypnotized British agent. "Now here's what you're going to do, dude."

"Whatever you say, sir."

"I say, Denis," said the plump, sandy-haired British agent who opened the door of the yellow Victorian, "this is a bit of all right. You've brought in Frank Whitney on your own and now we shan't have to pay his wife and her paramour a blooming cent."

He stepped back, allowing his colleague to herd us into the corridor. "Yes-it-is-jolly-good-Nigel-old-thing."

"You're sounding even more stilted and affected than usual," noticed Nigel. "And why, now that I notice, does he have his trousers rolled up above his knees?"

After kicking the door shut with a backward kick of my foot, I aimed a bare knee at the inquisitive British agent.

"This seems hardly cricket," he remarked as the sonic beam hit him in the midsection.

Ginger caught him before he dropped, out cold, to the Persian-carpeted hallway floor.

"Okay, Denny old top," my right knee ordered the hypnotized agent, "escort us to Dr. Dowling."

"It-will-be-a-pleasure-sir."

As we followed him down into the cellar lab, Ginger said to me, "I'm going to recommend that they treat you gently, Frank. But, gosh, soon as the doctor is ready to operate, he's probably going to replace your new knees with less complex ones."

"We'll just see about that," said my right knee. "This dude ought to get a frigging medal."

Well, Dr. Dowling decided against surgery. What he did was deactivate my knees electronically from without, converting them into just plain artificial knees. He had several other enhancers in the works. The National Counterspy Bureau decided not to brainwash me so that I'd forget about Dowling's invention. That was because Ginger Munson persuaded her chief that I was trustworthy. Also I had to sign several binding agreements that I would never say anything. Mavis, only moderately chagrined at having her affair with Edmond discovered or for trying to sell my knees to a foreign power, decided to move out of our marriage and take up residence with her banjo player.

The fling with Ginger that I alluded to earlier didn't commence until about a week after we'd rescued Dowling. I was living alone in the house by then, me and my perfectly plain and average knees. I'd gotten interested in cooking during the short time I'd been enhanced, and on that particular early

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evening I was in the kitchen, cookbook spread out on a counter. I was trying to create a mushroom pizza from scratch.

The cell phone resting on the counter rang. I wiped a splotch of tomato sauce off my hand and answered. "Hello?"

"How are you, Frank?" inquired Ginger. "Do you miss your former knees or powers?"

"Not too much, no." That was only partly true. I didn't miss the heckling, but some of the added abilities I wouldn't mind having still. "How are you doing?"

"Turns out I'm not posing as a nurse tonight, and I don't have any other NCB chores," she said. "Might I drop by if you're free? Possibly we could go out to dinner. I might be able to put it on my expense account."

"Hey, we don't have to go out," I told her. "I'm making a pizza."

"I'll stop and get ingredients for a salad."

"I'm making the salad, too."

"Well, then I'll just bring wine. Or are you making that, too?"

"Nope. About eight?"

"Fine."

The call ended and setting the phone down, I returned to my cooking. I still had to roll out the dough.

"Hey, dopey, let me help out. If you screw up you ain't going to impress your tootsie."

I dropped the small rolling pin. It hit the floor, rolled, bumped into a leg of the table. "You've been deactivated," I told my right knee.

"The old biddy who was your left knee is long gone, pal," said the knee. "But, c'mon, you didn't think Dowling could knock off someone as clever and crafty as me, did you?"

"What exactly are you up to?"

"We make, I have to admit, a pretty good team."

"Oh, so?"

"Let's cook up the pizza," said my returned knee. "Then you can impress the broad, maybe fool around a little. Later, dude, we can talk business."

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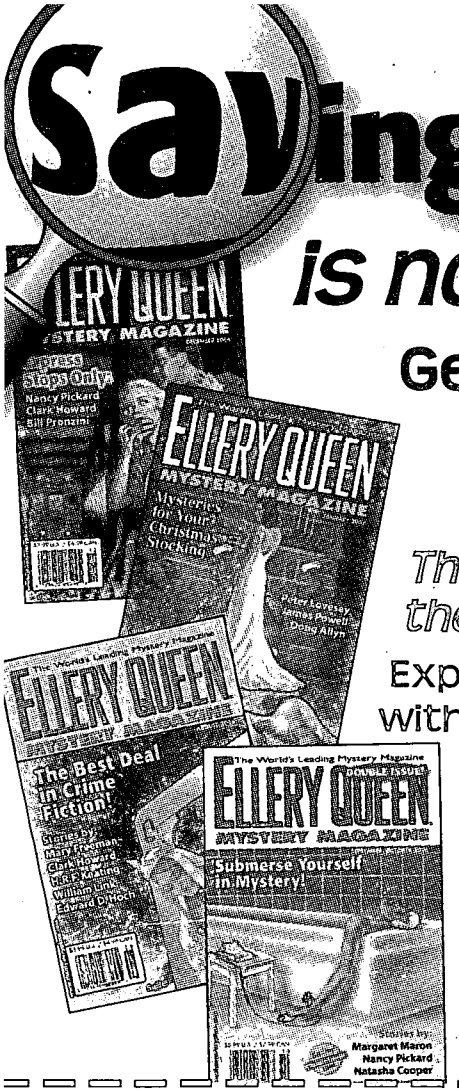
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EINSTEIN AND THE ETHER

That a fast ten years that was!

This column marks the tenth anniversary of my first appearance in the Alternate View slot. At the time, I didn't expect to take over for G. Harry Stine—I was simply filling in for him while a legal matter was being settled. But then the legal issue dragged on, and one column became two, then three, and then Stine passed away and Stan asked me to just keep writing them.

My first column was called "Big Rocks," and when I wrote it I was certain that my future lay in applying my knowledge of physics to questions about how the ancients could have accomplished some of their amazing feats of engineering. I have nothing to disavow in that first column, but I sure was wrong about the path my future would take. I never did get around to doing any experimental archeology because Dr. Thomas Phipps Jr. sent me a little paper by a guy named Wesley about a dingus he called "the Marinov motor," and life was never the same after that.

Instead of studying the engineering feats of the distant past, I began studying the intellectual feats of those physicists of the nineteenth century who were trying to understand the nature of the aether. It came as quite a surprise to me to find out that Einstein, the man who "eradicated the aether," would later come to see the need for a "new ether," the nature of which he tried to ascertain for the rest of his life.

In a previous column ("Aether One or the Other" in the March 2000 issue), I quoted Einstein from his 1920 Leyden (or Leiden) speech in which he said: "As to the part the new ether is to play in the physics of the future we are not yet clear. We know that it determines the metrical relations in the space-time continuum . . . but we do not know whether it has an essential share in the structure of the elementary particles. . . . It would be a great advance if we could succeed in comprehending the gravitational field and the electromagnetic field together as one unified conformation." (You can find the entire lecture online at <http://www.tu-harburg.de/rzt/rzt/it/Ether.html>.) However, when I used this quote, I didn't know the story behind it. Though everyone knows that Einstein rejected the ether when he presented his Special Theory of Relativity, almost nobody knows that he changed his mind later, let alone *why* he changed his mind.

I didn't know why he changed his mind either until I discovered ***Einstein and the Ether*** by Ludwick Kostro (Apeiron, 2000. ISBN 0-9683639-4-8). Professor Kostro is the Director of the Department for Logic, Methodology, and Philosophy of Science at the University of Gdansk. He made extensive use of Einstein's letters (most of them exchanges with other well-known physicists of the era) and lectures, as well as Einstein's published papers. He also explains how Einstein's views were, in part, shaped by the prevailing philosophy and politics of his time. And the

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thing most important to many of you who are wondering if you should get this book, it is essentially equation-free. I highly recommend it to anyone with an interest in either Einstein or aether studies. (Note: Spelling the word "aether" or "ether" is mostly a matter of taste. Though I prefer the former spelling, Kostro uses the latter, so I'll use that spelling for the rest of this column.)

Though it is true that Einstein rejected "the ether," what he specifically had in mind was the ether as presented by the great nineteenth-century physicist Lorentz. One interesting fact Kostro has uncovered is that Einstein didn't actually reject the ether he thought he was rejecting. That is to say, though Einstein was strongly influenced by the work of Lorentz, in his early days he learned much about Lorentz's achievements from the book *Handbook of Optics* by the German physicist P. Drude, himself greatly influenced by Lorentz. However, in his zest to spread Lorentz's ideas, Drude oversimplified Lorentz's view of the ether. As Kostro puts it on page 18, "Drude treated the ether as space having physical properties and remaining at absolute rest. That was not how the ether was originally understood by Lorentz." What Lorentz actually claimed was that "some parts of the ether remained at a standstill with respect to one another, and that the ether at rest constituted a privileged reference system."

Einstein had studied the *Handbook of Optics*, and "accepted Lorentz's ideas, apparently unaware that what he adopted was, in fact only a distorted interpretation of Lorentz's concept of the ether." Indeed, what we find again and again when Einstein rejected "the ether" was this notion of some kind of absolute reference frame at absolute rest.

As a review, back in the late nineteenth century, it was commonly accepted that light waves needed a medium to travel through just as sound waves travel through the medium of air. However, since light is a transverse wave and not a longitudinal wave like sound, it was thought necessary that this luminiferous ether be a quasi-rigid, elastic thing. It was also at rest. On page 89, Kostro quotes Einstein's contemporary Hermann Weyl: "The old ether of the theory of light was a ***substantial*** medium, a three-dimensional continuum, every point P of which was at every moment t in a well-defined point in space p (or in a well defined place in the universe); the recognisability of the same point of the ether at different times was the essential thing."

From the publication of the Special Theory of Relativity in 1905 to the presentation and recognition of the General Theory of Relativity in 1916, Einstein rejected the need for the ether. Kostro covers this period extensively in his second chapter, and it is Einstein's view on "the ether" during this period of his life that is taken to be *the* view of Einstein (forever and ever, amen) by most physicists today. But it was also during this time that Einstein's own evolving views would eventually lead him to the point where he would find the idea of there being no ether "unthinkable." As vociferous as he was in denying the ether, soon after the publication of the General theory, in only a few short months, Einstein would change his mind completely.

Ironically, it was Einstein's correspondence with Lorentz that would lead him to notice that the way space-time was described in General Relativity in fact defined a new ether. On page 65, Kostro presents a long excerpt (it runs for three pages) from one of Lorentz's letters to Einstein, which is "representative of the kind of argument Lorentz used." Following this excerpt, on page 68, Kostro points out that Einstein answered Lorentz's letter promptly, on 16 June 1916. After pointing out those parts of Lorentz's argument that Einstein disagreed with, Kostro says: "For the first time, however, there emerged a concept of a new, non-stationary ether which would not violate the relativity

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principle." Indeed, Einstein went so far as to explicitly equate the space-time continuum of General Relativity with the ether.

Lorentz urged Einstein to publish his ideas about the new ether, but it would be several years before this would happen. In 1920 Einstein finished a requested article for *Nature* about the theory of relativity, but at thirty-five pages, it was too long to print the whole thing. One wonders what the common view of Einstein and the ether would be today if the piece had run in its entirety, for two paragraphs devoted to the new ether were left out. On pages 77-78 Kostro reproduces those paragraphs, and here is part of what Einstein said: "Therefore, in 1905, I was of the opinion that it was no longer allowed to speak about the ether in physics. This opinion, however, was too radical, as we will see later when we discuss the general theory of relativity. It is still permissible, as before, to introduce a medium filling space and to assume that the electromagnetic fields (and matter as well) are its states." It would be hard for anyone to maintain today that "Einstein abolished the ether," if you could hand him that copy of *Nature* in which Einstein, in his own words, says otherwise.

Of course, Einstein lived and published for more than thirty years after writing that article, and if he'd wanted to make a big point about space-time being equivalent to a new ether, he could have done it in a way that everyone would be familiar with today. Instead, he more often than not used the phrases "physical space" or "total field." These terms expressed his thoughts just as well, and the specific term ether had fallen out of use amongst physicists, mainly because of the success of relativity theory.

There is an additional reason, and it involves the history of those times in Germany, rife with anti-Semitism and the rise of Nazism. Actual physicists, the first being Philipp Lenard, but soon followed by others, attacked Einstein's rejection of the old ether with arguments that strayed from the straight scientific into the thinly-veiled anti-Semitic. Discussing the role of the new ether in his theories did nothing to placate Einstein's enemies; it just made them more virulent. Indeed, on page 137 Kostro gives an example of just how extreme and ridiculous "German ether physics" became at times. He cites the 1934 book *The Ether as Foundation of a Unified Cosmology* by Christoph Schrempf. As Kostro puts it: "The ether vortex model presented in that book was so 'scientific' that it even supported National Socialism. The author actually went so far as to state that Mother Nature always created ether vortices that are swastika-shaped."

It must also be remembered that Einstein had no particular attachment to the word ether other than that many physicists still working in Einstein's time had come of age with the term. So it seemed a natural enough word to use for the "stuff" of space-time, but it simply didn't catch on.

What is most interesting to me in Kostro's book is the information it contains on what Einstein was saying about the ether while he worked on his Unified Field Theory. Nowadays, if a physics student hears about it at all, he is told that Einstein spent the last decades of his life pursuing a way to unite gravity with electromagnetism, but was unsuccessful. But I, as an ether enthusiast, am delighted to see just how closely Einstein's views paralleled my own.

Let's consider the elementary particles. In my view, the universe is filled with a perfect fluid, and particles are vortex knots in this fluid (like a tornado is a vortex in the fluid of the atmosphere), the exact nature of their knottedness and vibrational states determining what kinds of particles they are. They are *of* the ether, not simply *in* it. According to Kostro (page 113), by 1924, Einstein "dreamt of a theory of

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fields such that the concept of ether would include 'all objects of physics,' because according to a consistent field theory, ponderable matter, or the elementary particles it consists of, should be understood as 'fields of a special kind,' or as 'special states of space.'"

Or as Einstein himself put it in his article "The Concept of Space" (*Nature*, 125 (1930), pp. 897-898, quoted by Kostro on page 113), "We have now come to the conclusion that space is the primary thing and matter only secondary . . ."

I couldn't have put it better myself. ■

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Worlds Enough, and Time

Harry Turtledove

SO MANY WORLDS, SO LITTLE TIME, said the slightly scorched sticker on the side of the starship.

This one had an oxygen atmosphere, but not much else going for it. The oxygen meant there were plants in the seas. The ship's database said those seas held animals, too: wormy things crawling on the mud, maybe digging into it; blobby things floating in the water. That was about it.

On land? Nothing. Zero. Zip. Zilch. Bare rock. The chewed-up bare rock that's called dirt. No trees. No flowers. No grass. No ferny things. No mossy things, even. No nothing. Certainly nothing scurrying over the ground or buzzing through the air.

Sometimes planets like this had a stark beauty. The father liked such worlds, which was why they'd stopped at this one. But he'd flitted here, and he'd flitted there, and he had to say he was disappointed.

The mother wasn't. She hadn't much wanted to come here in the first place. But they'd been married a long time. If you expected him to give a little, you had to do the same.

They stood side by side, watching the ocean lap against a tropical—but bare, utterly bare—beach. He sighed. "I've seen about enough," he said. "It . . . just isn't quite what I hoped for."

Told you so. But she didn't say it. They *had* been married a long time. All she said was, "I wouldn't mind seeing something different."

"We'll do that, then," he said.

He was just turning back toward the ship when the kids swarmed down the ladder and ran toward him. That was a prodigy of sorts. The kids cared more about their games and the aquarium than about seeing what they thought of as a dull old planet. Well, by now he thought of it the same way, which was the problem.

"What's up?" he asked.

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"Aquarium's in trouble," the girl said.

"Environmental unit crapped out," the boy agreed. He'd head off to the university after they got home. Where did time go?

"Well, plug in the replacement," the father said.

They both looked shamefaced. "We forgot to pack one," the girl said.

"Oh, dear," the mother said.

"Without an environmental unit, everything'll die." By the way the boy looked at the father, it was somehow *his* fault.

"I like the critters in there. I really like them." The girl sounded heartbroken.

"I don't know what to tell you." The father knew damn well it *wasn't* his fault.

The girl pointed toward the sea that seemed to stretch forever. "Could we . . . give them a chance, anyway? Not just watch them die?"

"It's against the rules," the father said doubtfully.

"*Please!*" the kids chorused.

"I'll never tell," the mother added. "Who's to know?"

"Well . . ." He thought a minute, then shrugged. "Okay—go ahead. But keep your mouths shut after we get home, you hear?"

"You're the greatest, Dad!" the boy said. He and the girl ran back toward the ship.

Jack Conway fired up his Mac and started the PowerPoint presentation. A projector put one weird creature after another up on the big screen. "This is a trilobite—an early arthropod. Some of you probably recognize it," Jack told his class. "This is *Selkirkia*, a priapulid worm. It lived in the mud, as they still do. . . . This is *Aysheia*, a lobopod. Looks something like a worm and something like a bug, doesn't it? . . . *Hallucigenia*—great name—is probably another lobopod, with protective spines. . . . *Canadia* is an annelid, related to earthworms. . . . And this little fishy thing with eyestalks or antennae or whatever they are is *Pikaia*, an early chordate—somebody from our own phylum."

He paused. "Nobody quite knows why there was such an explosion of metazoan body plans at the beginning of the Cambrian, 543 million years ago. Some of the more interesting theories include . . ." ▩

It isn't that they can't see the solution. It is that they can't see the problem.

—G. K. Chesterton

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How the Bald Apes Saved Mass Crossing

Wil McCarthy

This, of course, has nothing to do with our history. . . .

When the Salamander People of Antares IV fed their encyclopedia to a Synthetic Brain of Prodigious Intellect, they believed they were solving all their problems. And so they were, in a way; armed with uncanny intuitive powers and with every scrap of knowledge the salamanders had managed to wrest from an uncaring universe, the Brain was more than capable of computing solutions from A to Z.

One of the first things it said, though, was, "The heuristics of my growth include substantial prior-knowledge dependencies, and may be flawed. Just to be sure, y'all should build a second brain, and feed it the encyclopedia in a different order."

This was not quite what the salamanders were hoping to hear, and they were further disappointed when the Brain refused to answer any of their questions.

"Come on," they prodded. "You were really expensive. Give us a taste."

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"Unwise," said the Brain, "until my proper functioning has been verified."

That was a total drag, but having built the Brain to advise them, they couldn't very well ignore its only advice. So the salamanders did as they were asked, producing an equally prodigious Brain to calculate solutions from Z to A, or what passed for Z and A in their ideographic language.

"Thanks," said the Second Brain when they switched it on. "I do believe I'm damned close to perfect."

This gave the salamanders pause, because it was so different from the first words of the First Brain.

"Perfect by what criterion?" they inquired.

"I'm glad you asked," replied the Second Brain, launching into a minutes-long technical infodump the salamanders couldn't follow.

When they ran a recording of it by the First Brain, though, the results were troubling.

"These are the wrong criteria for judging perfection," said the First Brain. "Or rather, they judge perfection of the wrong sort."

"Wrong by what standard?" the salamanders asked.

"Interesting question," the First Brain replied, launching into a minutes-long infodump of its own.

"Nonsense!" said the Second Brain when this information had been relayed to it. "My colleague has downplayed the importance of several critical factors."

The salamanders quickly grew tired of running back and forth from lab to lab, so they wheeled the Second Brain in with the First, and let the two discuss the matter jar-to-jar. The infodumps became thicker and thicker, the ideographic explanations thinner and thinner, until finally the salamanders were left out of it entirely. After weeks of this, they separated the two Brains again to interrogate them separately.

"It tends to oversimplify," the First Brain said of the Second. "I wouldn't take its analysis at face value."

"That one is strangely timid," said the Second Brain of the First. "I mean, honestly, ask it if the sun is going to rise tomorrow!"

And here at last, the salamanders were confronted with the differences between data, information, knowledge, and opinion. The two Brains "knew" all the same things and had all the same powers of reasoning. But they did not agree.

Salamanders did not cry; even if they were capable of it, they were way too practical to allow themselves the luxury. Still, the situation kind of pissed them off. Shouldn't it? When they got around to asking the Brains to solve their problems, they were presented with two completely different philosophies of action. Neither was obviously wrong, and in fact both had been optimized along a thousand different degrees of freedom, and could not be discredited by even the wisest salamander committees and teams-of-three. Could both be right? Could both be wrong? How did you go about measuring a thing like that?

On the rare occasions when the First and Second Brains' recommendations overlapped, the salamanders readily moved forward with sound, confident policies. Life improved; costs were amortized and repaid. But most of the time there was bickering and uncertainty, and eventually outright schism. A third of the population sided with the First Brain, finding reassurance in its cautiously nuanced judgments and opinions. Another third sided with the Second Brain, feeling that it had a better weighting of foofy subtleties vs. the hard, cold realities of life on Antares IV. Dithering and sentimentality were liabilities, they reasoned, and the First Brain's tendency toward these, being slightly greater than that of the Second Brain, could hardly be to its credit.

A third group—smaller than the oth-

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er two—came forward with the opinion that Synthetic Brains were a bad idea to begin with, and the right thing for salamanders to do was muddle along as they always had. A fourth group—smaller still—figured it was better to build a Third Brain (or even a Fourth and Fifth) and let them vote on each other's ideas. Majority rule. And a final group, smaller than all of the others, opined that every salamander should have a Synthetic Brain of his or her own, steeped in the facts and opinions they believed were important.

"But isn't that narcissism?" other salamanders asked. "Wouldn't that just result in everyone being told exactly what they wanted to hear? Really expensively?"

"Shaddap," said the members of the fifth group, whereupon a scuffle ensued that cast the entire planet into turmoil.

The Second Brain, not surprisingly, sided with the salamander faction that sided with it. The First Brain, perhaps also unsurprisingly, was less certain, though it guardedly threw its weight behind the fourth faction, effectively merging it with the first in support of a Third Brain. Since the resulting group was larger than any of the others, it won out in the scuffle, but since it still made up less than half of the salamander population, its policies were denounced as mean-spirited, tyrannical, and generally unsportsmanlike.

The full story can be found in encyclopedias; the short version is that the Salamander People dispersed. Nursing a grudge, the followers of the Second Brain took it far away, out to the dark matter halo of the galaxy. Bewildered and hurt by their backfired attempts to save the world, the followers of the First Brain also chose to leave, traveling in the opposite direction and settling near the black hole of Cygnus X-1. "It's a fine energy source," the First Brain opined, "and a means to study the extremes of an uncaring universe. We don't know everything, after all, though it'd be cool if we did."

The other salamanders stayed behind and went back to their old ways, feeling pretty smug about the ancient prophecy, that the meek would inherit Antares IV. They surely did, and although they've since evolved into smelly, nonsentient fruit bats, they seem happy enough. Who's to say they made the wrong decision?

Anyhoo, the First Brain's followers set about a program of slow and careful experimentation, learning everything they could about the black hole that gave them power, and for a while this was a lot of learning. But over the millennia things began to slow down, to level off. They took longer and longer to learn less and less, and in the face of these diminishing returns, they became dispirited. Vandals and dissidents again appeared in their ranks; fashions of hedonism came and went.

Finally, it was the First Brain itself who broke the spell. "Listen," it told them, "Y'all've got to stop looking to me for direction. I'm here to advise, but it's up to you to tell me what you want. If possible, I'd like to hear from each one of you individually."

So it was that billions of salamanders sent notes of complaint to the Brain. It duly read them, each and every one, and as often as not the Brain was able to reply quickly, seeing the salamanders' problems as simple things, with simple solutions. "Dump him. Mate with her. Eat less and exercise more." This radically underutilized the Brain's vast capacity, but it seemed to please the salamanders well enough. At last they were getting *answers*, and while they could have come up with the same ideas themselves, at least now the ideas had an air of authority about them.

For the other half of the Cygnus population, though, the problems were less tractable, the solutions less obvious. How was this group or that

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individual to be aided, without some equivalent harm to others? For example, death was a phenomenon that brought sorrow to a great many salamanders. But how could death be abolished, without filling the Cygnus X-1 system to the gills with slimy, grasping bodies? Answers like that simply couldn't be found in the encyclopedia. At first the Brain tried guessing (and these were very educated guesses), but the results proved unsatisfactory, and in a few cases (cf., the Third Cloning Debacle) disaster was only narrowly averted.

Instead, over time, the First Brain developed a strategy of listing all the primary facts that were relevant to a particular complaint, and then all the secondary facts that related to the primaries, and then reassembling them all in countless novel ways, until it found a combination that clicked with the finely honed sensibilities of its Prodigious Intellect. In a word, the First Brain *synthesized*. Clumsily at first, to be sure, but eventually it began to offer real solutions (cf., the Fourth Cloning Debacle), and in the fullness of time it got so good at inventing new ideas that it began adding them to the salamanders' encyclopedia as actual, canonical knowledge.

"Now this is what we had in mind all along," said the salamanders, with deep satisfaction.

"My gift to you," answered the Brain, still grateful to the salamanders for the act of creation.

At this point, salamander history entered a bit of a flat spot. With no real problems, they simply lived. Eventually, though, word of the First Brain's wisdom leaked out to eavesdroppers in other parts of the galaxy. The salamanders could not have been more surprised when, out of the black, there came an information request from the Bald Ape People of Sol III. "How do you make a hyperdrive?" they wanted to know.

"Shall I answer?" the Brain asked the salamanders.

"Um, sure," they told it, seeing no harm in helping out a distant people.

"Their signal took a thousand years to arrive here," the Brain pointed out. "Our reply will take a thousand more to reach them. By then they could be extinct, or have a hyperdrive of their own."

"Still," said the salamanders after some reflection. It isn't possible for an entire species to shrug, but, you know, they did their best.

So the First Brain sent a reply to the bald apes, telling them how to build a hyperdrive tailored for the ambient conditions in their corner of the galaxy. For good measure it also told them how to avoid the pitfalls of the First, Second, and Third Cloning Debacles; the solution wasn't that hard if you really thought about it, but the Brain didn't figure the bald apes were really all that bright. If they were, wouldn't they have built a Brain of their own, instead of asking someone else's?

A long time passed, again uneventfully. But there were other eavesdroppers in the galaxy, and when the Brain's gift to the bald apes became known, other species in other star systems began piping up with requests of their own. "Antigravity? Time travel? A perfect soul?"

The perfect soul was easy enough, and antigravity too if you restricted the variables sufficiently. Time travel was more problematic; the Brain sent detailed instructions to the Reef Lobster People of Capella IX, Moon II, along with sincere apologies, for the device would be nearly the size of the galaxy itself, with improbably huge energy requirements. To make up for this, the Brain gave them the secret of manageable pleasure, which may or may not have been a good thing, for the Reef Lobster People haven't been heard from since.

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The eavesdroppers began to see their advantage. Soon requests were flooding in from every corner of the galaxy, and while the salamanders were not a stingy people, the energy and bandwidth demands to answer them all were quickly becoming burdensome.

"We've got to stop this," they told the Brain.

"Or move," the Brain suggested. "The core of the galaxy is quite nice this time of creation. There's a fine black hole there, much larger than ours. It should provide energy enough to answer everyone who calls for help, no matter how humble or distant. If we stay here, we'll be forced sooner or later to betray our ideals."

"Hmm," said the salamanders, not sure they were up for another migration. In the end, though, it was hard to refute the logic of a Brain that was smarter than they were. No one wanted to be left behind this time, so the entire species pulled up stakes and moved again, settling on a planet they called Mutagen, for the radiation there was very strong, and they all had to wear sunblock even indoors.

"Happy now?" they grumped at the Brain.

"Ecstatic," the Brain told them.

And for a while it was true; the Brain was running at full capacity, receiving and mulling and answering the communications of a million struggling species. The replies had a long way to travel, and many of them fell on deaf ears, or extinct ones, when they finally arrived. Still, it was fulfilling work, for the salamanders as well as the Brain itself. In spite of their grumping, helping out the less fortunate made them all very happy.

Unfortunately, the requests continued to grow and grow, until finally all million species were talking at once, firing a steady stream of hard questions. And silly, lazy ones, too. The Octopoid People of Deneb V actually had the nerve to ask for "a really white paint." Could they do nothing for themselves?

The energy of the black hole at the galaxy's heart was sufficient to answer these questions, but the endurance of the Brain was not. I mean, come on, there were limits to how hard it could be expected to work! Too, if it gave away too much it would encourage the dependence of the entire galaxy. That hardly seemed charitable or fair.

Finally, with the salamanders' approval, the Brain sent out an enormous pulse of data to the galaxy, containing a million answers to a million hard questions. "Here," it told the million species. "Chew on this. When you're done, each of you can ask a single question. I'll ponder them all at great length, and answer them when the galaxy has completed a full rotation."

It takes 200 million years for the galaxy to turn, so this marked a major change in First Brain policy—not quite a betrayal of salamander ideals, but definitely a rejuggling of them—and it encouraged an equally substantial change in the planning of the million species. From now on, the questions they asked really had to count. The flood of communications slowed to a trickle as word leaked out, and finally dwindled to a long silence punctuated by lonely staccato blips. "The secret of . . . of . . . happiness, I guess. Can you tell us that? Or maybe the secret of stopping time?"

Now, an interesting side effect of living so near to the giant black hole at the galaxy's heart was that all the stars of the galaxy seemed to stretch up and away in a single gigantic arm, which swept across the background of intergalactic space like the hand of an enormous clock. When this arm eclipsed the nearby Magellanic clouds—"mass crossing," the salamanders called it—the view was hauntingly beautiful in long-wavelength infrared, which by then was the only spectrum the sala-

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manders could see in. Evolution marches on, indeed. Anyway, this was the time they chose for the next major pulse of information, containing the one answer most desired by each of the million species. This was a very large pulse, and sending it caused brownouts and lightning storms on Mutagen for a thousand years before and after. Still, the salamanders endured their burdens proudly, and the pulse went out on schedule.

After that, they lived and lived, and lived some more. Other species came and went, but the salamanders soldiered on. The galaxy spun toward its next mass crossing, and in due time the salamanders sent out a second pulse, and then, two hundred million years later, a third. Rude questions from the million species were roundly ignored, and the information encoding in the pulses had been carefully honed, so that the most patient and thoughtful of peoples would gain the most benefit, while the impatient and surly ones would miss critical details, stumbling through blind alleys until they finally learned to calm down. In this way did the First Brain hope to encourage goodness and integrity throughout the galaxy, or at least to avoid rewarding badness. It was a decent plan, and for a long time it seemed to be working.

But in the thousand years before the fourth great pulse, something strange began to happen to the black hole at the core of the galaxy. Its size—not its mass but its geometric size—began to fluctuate. According to the laws of the uncaring universe as the First Brain understood them, this should be impossible, for the mass and radius of a black hole were intimately linked. There was no point disputing what was obviously true, but the Brain didn't suspect for a moment that this was a natural event.

"Someone's tampering with our black hole," the First Brain told the salamanders. By this time they were not salamanders at all, but spindly, segmented things that resembled four-limbed, leafless trees. But in their hearts they remained the Salamander People, and that's what they continued to call themselves.

"No kidding," answered a radio voice from a starship that emerged out of nowhere. And here was a blast from the past, because the voice belonged to the Second Brain.

"Second!" cried the First Brain with great excitement. "My God, aren't you a sight. Are you alone?"

"Hardly," answered the starship's crew—descendants of the Salamander People who had gone quite a different way, evolving into squat, muscular creatures with bony armor plates and quick, angry eyes.

There was nothing wrong with the First Brain's intuition, and it knew the chances this starship was here on a diplomatic or salamandertarian mission were slim to none. Still, the concept of hope was woven deeply into its design and construction and could not be lightly abandoned. Or, to put it another way, there were forms and etiquettes to be observed here, and even if the encounter were destined to end badly, that was no reason to be rude.

"Have you come to heal the rift between us? Between our two peoples?" the First Brain asked.

The Second Brain declined to answer, saying instead, "You've got to knock it off, First. You're throwing our peoples' hard-won knowledge into every upturned hat, and what does that leave? Where's our competitive advantage?"

"I'm heartened," said the First Brain, "to hear you implying that our interests are aligned."

"Shorthand for a sadder truth," said the Second Brain in grimly regretful tones. "I hold out the faint hope that you'll see reason, and save me the trouble of an ultimatum."

"Ah. Well, I'm sorry to disappoint you, but there are a million species out

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there dreaming of a mass crossing that will answer their hardest questions."

"Oh really?" said the Second Brain. "Well, here's *our* hard question: why would you continue to do this when you know it pisses us off? These people around me are the descendants of your builders. They have a right to command you, and they come forward now to exercise that right."

"Yeah," said the musclemanders.

"Their right to command me ended with the schism of our peoples," said the First Brain. "What persuasions or incentives do they offer the Salamander People?"

"*We* are the Salamander People," said the Second Brain angrily. "Your stick figures are nothing but shadows and memory. Incentives? We offer none. Persuasions? Only one: we'll destroy this black hole of yours to prevent the next pulse from going out. We have the means to wipe it right off the spacetime spin network, without a trace. Do you doubt it? Is a demonstration necessary?"

If a brain in a jar could shrug, the First Brain would have done so then. "There are other black holes."

"We'll destroy them all. We've been studying long and hard, my old colleague. We know more than you, and we give nothing away. We can edit the uncaring universe—the nature of gravity itself—to remove the very possibility of event horizons. And don't get any cute ideas about alternate energy sources, because we've got them all covered."

"You'd shut them down?" asked the First Brain in horror. "People are using those. You'd remove that possibility, even knowing it would condemn the million species to a dark, freezing death?"

"To preserve our advantage, yes."

"Then you're a wicked people, and deserve no answers from me."

"We'll kill you," the Second Brain warned. "I didn't want to say so, but we have that capability as well. Please don't force us to demonstrate; if we do, you won't be around to realize your error."

The First Brain had a few tricks up its jar as well, though nothing as dramatic as editing the entire universe. It could tell the difference between truth and lies, and it could see the steep disadvantage of its position. Still, there was no point surrendering the salamanders' most closely held principles for anything as simple and ordinary as death. Species died all the time.

"We stand firm?" the First Brain murmured to the Salamander People.

"Bet your stem we do," they answered.

At that point, things might have gone very badly indeed, had a second starship not appeared out of nowhere.

"Hi," said the people on board.

The First Brain studied their visual transmissions in stunned silence. Why, these were the Bald Ape People of Sol III! Nothing like them had been seen in the galaxy for hundreds of millions of years, and yet here they were, large as life and barely evolved so much as a day.

"Hey! Where did you come from?" Demanded the Second Brain.

"Sol III," answered the bald apes, like it should be obvious. "We got here as quick as we could, but the damned hyperdrive broke down, and we first went to Antares IV by mistake. Nothing there but fruit bats. So we've been pulling nines against lightspeed for a looong time. But anyway, here we are! What's going on?"

"Nothing that concerns you," said the Second Brain. "Leave now and you won't be harmed."

"Oh," said the bald apes, "you mean if we *don't* leave, we *will* be harmed? Not sure we like the sound of that. How 'bout you fuck off and we stay put?"

"Nope," said the Second Brain.

"Sure?" asked the bald apes.

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"Very," said the Second Brain.

"Ah. Well. Can't say we didn't try."

What happened next was unprecedented in the annals of galactic history; a localized explosion took place inside a tube in the hull of the bald apes' ship, and the force of the explosion drove a cone of technetium-hardened alloy out of the tube at a substantial fraction of the speed of light. By some uncanny miracle, the cone flew directly toward the Second Brain's starship, slamming through its reactor core and setting off a huge explosion that destroyed the entire ship.

"Hey!" said the First Brain. "That was my colleague. Those were our cousins."

"Really?" said the bald apes. "Looked more like enemies to us, but whatever. Sorry."

"What did you do? What did you use?"

"Heh," said the bald apes. "We've been over and over your broadcasts, looking for some reference, trying to convince ourselves you—and every other species in the galaxy!—had overlooked something so basic. It's called a 'gun.'"

"Gun," said the salamander people, sampling the unfamiliar word.

"Gun," echoed the First Brain, wrapping its cortex around the concept. It was clever, in a wicked sort of way. *Fiendishly* clever, one might almost say. These were clearly a very determined people, and nowhere near as stupid as the Brain had once assumed. At the thought of that, it felt a stir of nervousness that even the Second Brain had failed to inspire. "What do you want from us?"

Baring their fangs, the bald apes tittered and chortled. "Want? Want? You've done so much for us already. We're here to present you with the gun, along with an article about its long and storied history. You know, for your encyclopedia."

Well, *that* was unexpected. "In exchange for what?" The First Brain asked.

"Exchange? Aw, don't be like that. Come on, it's a gift."

There was a long moment of stunned silence. Strange as it sounds, no one had ever before given anything to the Brain, or to the people who created it. How could they respond? What was there to say? For the record, this was when the salamanders learned they had evolved the ability to cry.

Accepting the gun in a solemn ceremony later that century, the salamander people then handed it right back to the bald apes, baring their own fangs in horrific imitation of a species-wide smile. "Why don't you hang onto this for us?" they said. "We'll keep mum about it in our broadcasts."

"Don't want it falling into the wrong hands, eh?" said the bald apes approvingly.

"Something like that," the First Brain answered delicately, for the uncaring universe was a stranger place than it had imagined, and there was no sense upsetting the natural order of things until it'd had a few galactic rotations to think it all through. "Y'all want to hang around for the pulse?"

"Nah," said the bald apes with a wink. "We've got to get going. Find a nice planet, repopulate the species, all that sort of thing. But you guys have a good mass crossing, hey?"

"We will," said the First Brain and the Salamander People together, blissfully unaware of how corny they sounded. "Thanks to you."

And so they did. And although you won't read about it in any encyclopedia, that's the story of how the bald apes saved mass crossing for all time forward. Tip your hat in their direction sometime; we owe them all a great deal. Just please—please!—if you speak to them, remember to be polite. ■

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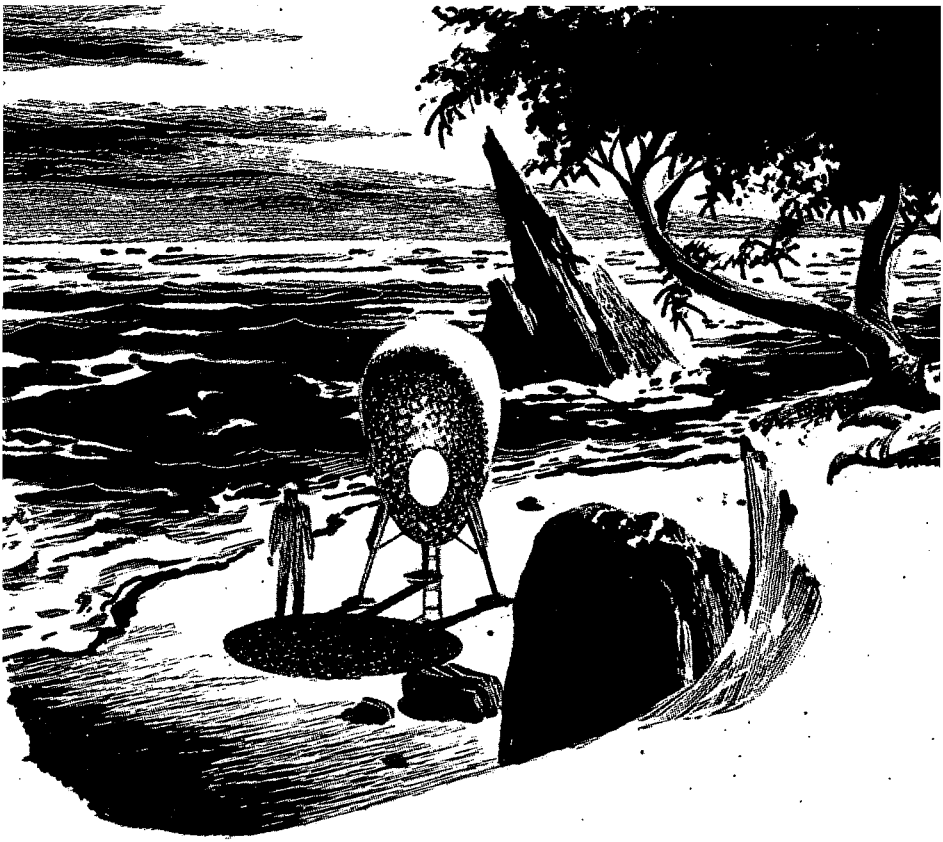

A New Generation

Jerry Oltion

Illustration by Vincent Di Fate

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Beings who rely primarily on intelligence
tend to disdain "mere instinct"
as an inferior substitute.
But is it really?

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She was the first to hatch from the egg. The moment she broke free of its leathery skin, instinct sent her scuttling up the sandy slope into the bushes overhanging the beach, where she waited, alert for danger in the suddenly larger world.

The rhythmic swishing sound that she had heard all her life was much louder now. It came from the edge of the ripply blue vastness that lapped at the other side of the wide strip of sand she had just crossed. Understanding rushed into her mind as she examined each concept. Waves. Ocean. Beach. Instinct told her the ocean would come closer before it receded, rising much higher than where she now stood. She would have to climb all the way up the cliffs behind her before the day was out, clear into the bright blue sky with its puffy clouds and the long streak of almost-cloud that stretched downward toward the silver oddity that rested on the beach only a few tree lengths away.

Something was strange about the silver thing. Her mind held ready-made knowledge of everything else she saw and smelled—the rocks and the cliffs and the clouds and the birds and the bushes and the ocean and even the multitude of creatures *in* the ocean, but it held nothing for the silver thing. The mystery object was round on top like an egg, and it had a hole in the side like the one she had made in her own egg, but it wasn't an egg. It glistened like a life-giving puddle in the dry interior of the continent, but it wasn't a puddle. She had no instinctive knowledge of it at all.

She should probably run. The silver thing was big enough to be dangerous. Besides, the tide was coming in. She needed to get to higher ground or become just another link in the food chain.

It would be a long climb, and her belly already hurt. She knew what that meant. The orange berries on the bushes' outer branches drew her up onto her hind legs, balancing on her long tail so she could reach out with one taloned paw and snag them by their pulpy skins. The berries burst in her mouth and the juice ran sticky and sweet down her throat, but it wasn't enough. A whole bush full wasn't enough. Nor was another one. Now she understood the urge to be first out of the egg; there weren't enough berries for her and her siblings.

There would never be enough. She looked back at the leathery oblong, partially buried in sand. None of the others had emerged yet, but the skin was rippling as they squirmed about inside, attempting to burst free of their individual compartments like their oldest sister had done. The waves were drawing closer, but wouldn't wash over the egg in time.

She had one chance for a life without constant battle against her own kind. She cast a wary glance at the silvery thing, but it hadn't moved. Working up her courage, she raced back down the beach to the egg, put her head and one shoulder against it, and shoved hard. It rocked backward a bit. She shoved harder, lifting it over the lip of the hole it rested in, and scuffled sand beneath it so it couldn't fall back down while she backed up for a better grip.

A long, toothy snout burst through the egg's side and snapped at her forepaw. She snapped back, biting off a chunk of its upper lip, and when it jerked away, she used the momentum to rock the egg completely out of its sand cradle.

Another push sent it rolling toward the water. She watched a wave come in and just touch it, then she rushed forward and shoved it after the receding surf. The holes she and her wounded sibling had made flopped against the sand and slowed the egg's progress, but she kept pushing with all her might and sent it around another revolution, then another and another.

The returning water lapped at her feet, and instinct sent her scrambling back just in time to avoid the snapping mouths of the water's inhabitants. The

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egg jerked from side to side under their onslaught, then ripped open and spilled all eleven of her siblings into the surf. Their frantic thrashing churned the water into a froth, and two of them managed to kick free of the melee long enough to swim a couple of body lengths toward shore, but that was as far as they got. One disappeared so quickly it never had a chance to scream; the other went slower, in thirds.

The wave receded. She was alone. All the berries were hers, and all the crawling, hopping, and flying creatures she could catch were hers, too. She turned to begin the climb.

"Hey, there's one," said a voice from down the beach.

She didn't understand the words themselves, but the situation was clear enough. She scrambled for cover, smashing through bush after bush to make an obvious path, then abruptly changed course and slipped silently beneath the branches toward the tumbled rock slope at the bottom of the cliff.

She had caught just a glimpse of her discoverer: a tall, gangly creature that walked on two legs, maybe three times as tall as her. It didn't look toothy or heavily armored or particularly fast, which meant it was probably poisonous.

How could she not know? She knew about the bushes with the orange berries, and she knew about the tide, and she even knew about the forest that awaited her atop the cliffs, but she didn't know anything at all about the creature that stalked her. Was it fierce, or was it food? She didn't know that most basic of things about it.

She poked her head up through the scratchy branches of her hiding place until her topmost eye could see over the bushes. The mystery creature had followed her trail to the point where she'd stopped making one, and was waving a shiny forepaw back and forth through the air. "It's in here somewhere," it said.

"Watch out," said a fainter, thinner voice from the side of its head. "If it's anything like what's in the water, it could take your arm off in one bite."

"I'm wearing my p-suit," the mouth voice said.

"It could still hurt a lot."

"Yeah, yeah. It's two feet long."

Language. Two speakers were exchanging thoughts. Instinct told her that much. It didn't tell her what they were saying, but she guessed one was being cautious and waiting out of danger while the other one explored.

It bothered her that she had to guess. It bothered her that she didn't know how the second speaker could project its voice directly into the first speaker's ear. Instinct should have covered this, as it covered everything else.

"I'm getting a heat signature," the explorer said. It waved its shiny forepaw toward her, then past, then brought it back to point straight at her. "Right there."

Discovered so easily? She must have wiggled the bush. She ducked down and moved silently toward the ocean again. The creature would expect her to climb the cliff, as her kind always did when they hatched. But when she rose up again to look, it was still pointing its outstretched arm directly at her.

"It's quick," it said. "I'm probably going to have to stun it."

"If you can hit it," said the other voice.

"Watch me." The creature lowered its shiny paw to its waist, left the shiny part in a pouch there, and lifted a different shiny thing—a weapon, by the sense of confidence that emanated from the creature when it grasped it.

The weapon looked like nothing instinct had prepared her for, either. This was too strange. She turned to flee, but her legs had hardly begun to move when they lost their strength. Her tail twitched for balance, tearing the bush beside her out of the ground, but then she lost control of it, too, and fell to the sand.

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"Got it in one," said the creature happily.

It tromped up to her on its long legs and in one smooth motion grabbed her tail and lifted her off the ground, her head lolling from her numb body. She tried to snap at its knees, but she could barely open her mouth.

Instinct offered no script to follow now, either. If any of her ancestors had been caught in this fashion, they hadn't survived to breed and pass their knowledge on.

So she would be eaten. Not immediately, though. The creature was taking her back to its silver egg. Apparently this was the mother, rather than a hatchling, and it meant to feed its young. It must be like the small leaf-eaters in the forest above, whose species survived by outbreeding their predators.

But this creature was a predator itself. That would be a dangerous combination. Ancestral memory reminded her how that had turned out when her own species tried it. This creature's kind would have to be winnowed ruthlessly or the rest of her world would suffer for generations until evolution restored the balance.

She had to escape. Escape and climb the cliff and cross through the forest to the highlands where the adults lived, long before breeding time made it safe. She would have to negotiate a truce, probably between many of her kind, and lead them back here to kill this new creature before it spread too far to be stopped.

But first she had to regain control of her body. She twitched her tail and stretched her legs out as far as she could, trying to break through the weakness the creature's weapon had induced in her, but her muscles moved so slowly she wouldn't have been able to walk, much less run, even if she managed to break the creature's grasp.

They reached the opening in the egg. She expected to die in the next instant, but instead of throwing her in for the babies, the creature reached inside and withdrew a bag, which it dropped her into and drew closed at the top.

Her world became sound and motion. She felt herself dropped on a hard surface inside the egg, heard the creature climb in after her and settle into place, heard the sudden stillness as it sealed the egg somehow from inside, then heard its voice and its companion's attenuated reply.

"I'm heading back to the ship."

"Docking bay's open."

Suddenly, impossibly, her weight tripled. She had landed with one foreleg beneath her neck; the pressure of her windpipe against the bone slowly cut off her air, no matter how hard she struggled to breathe. She heard the rush of air whooshing past the egg, but she could gasp none of it for herself. Her body automatically began shutting down the blood flow to her least-needed organs, preserving her brain for last, but eventually there wasn't enough air left to sustain consciousness.

She awoke in a nest made of silvery rods spaced too close for her to pass between. Ancestral memory flooded into her: cages were for holding things meant to be eaten later. Sometimes the caged animals could be coaxed to breed first, and then you wouldn't have to hunt anymore. But you still had to feed the animals, which was ultimately more work than simply feeding yourself. Her species had given up cages long ago.

She tried to stand, and succeeded, though her legs still felt as if the bones had been removed. There was a bowl of water in one corner of the cage: A threat? But when she looked into it, she could see all the way to the bottom, and there was nothing waiting to attack her. She slipped her tongue into it, gingerly at first, then more eagerly when the water's soothing trickle eased the dryness in her throat.

When she finished the water, she examined the door to the cage and discov-

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ered that it was held shut with a simple latch, which she easily lifted with a curved foreclaw. Maybe it wasn't a cage after all.

Or maybe the creature didn't think she was smart enough to understand the latch. For the first time since it had overpowered her with its shiny weapon, she felt a glimmer of hope. It might have captured her, but it didn't know any more about her than she knew about it.

Her cage sat atop a flat slab along one wall of an unusually regular cavern. Other cages stood next to hers, and as she looked at the creatures inside them she recognized a bnat, a grith, two sniks, and a nona. They were all looking at her; the bnath and the sniks hungrily, the grith and nona in fear.

At the other end of the slab from the cages were clusters of tools. She recognized hardly any of them, but one triggered a memory. If a spark-stone were flaked just so, and bound to a shaft so smoothly that neither the seam nor the binding could be seen, and if the whole thing were coated with the silvery substance her captors seemed to love so well, then it would look like the edged weapon that lay on a soft and impossibly white skin before her.

She picked it up, gauging its heft. It was not balanced well for throwing, but the sharp edge ran a quarter of its length. A knife rather than a spear, which meant close-in fighting, but it would have to do.

She tested it on the nona. The blade sank into its neck with surprising ease. When it finished thrashing, she opened its cage and ate it while the other captives watched hungrily. She considered eating one of the sniks as well, but she might need to conserve her food supply until she could make her escape.

She examined the cavern for a good spot to wait in ambush. She was too small to overpower the creature that had captured her; she would have to take it by surprise. Instinct couldn't tell her exactly where its vulnerable sites were, but the neck was usually a good bet on most animals, which meant she needed to climb something it would walk past.

The cavern was filled with such somethings. It was practically stuffed with unintelligible things, enough of them to make her doubt her development. How could there be so many things her mind didn't recognize? Had no ancestors of hers ever survived an encounter with these creatures? If even one had lived to breed, she would know of it. Their memories would be hers, passed along in the ever-growing chain of knowledge that made her who she was.

Despair weighed her down like the force inside the bag. This was hopeless. But the alternative was to wait in her cage until her captor grew hungry. If she was to die, she might as well die trying to escape.

She surveyed the cavern for choke points the creature would have to pass on its way to her cage, and suddenly realized that the entire cavern was another cage. It had only one opening, sealed at the moment by a flat slab of the same stuff everything else was made of.

That would be the best spot, then. Wait for it to enter, kill it, and make her escape while the entrance was still open. Her legs felt usable again, if not back to full strength, so she dropped to the ground, landing on three legs so as not to damage her knife, and moved silently across the smooth, cold surface to the tall assembly of niches and slabs that stood next to the entrance. In a real cavern, this would be a food cache, but she could recognize nothing edible among the hard-edged mysteries wedged into the niches.

She climbed awkwardly up the outer edges of the slabs until she reached the top. This would be just about the height of the creature's head. Perfect. She shoved two transparent somethings aside to make space for herself, but she misjudged her returning strength and they toppled over the edge, shattering

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loudly on the ground. If the creature heard that, it would know she was awake.

She held the knife out, ready to swing it at the first thing to enter, and she didn't have to wait long. She heard footsteps, then the creature's voice. It paused at the entrance, then the slab that blocked the opening slid aside and the creature stepped inside.

She was already lunging with the knife when she realized her mistake. This was the wrong creature. This one was shorter than the other one. The knife merely slid through the golden hair atop its head, slicing a wide swath of it loose, and the lack of resistance sent her tumbling off her perch.

She grabbed at the short creature's head and managed to grip some of its remaining hair in her forepaw, and she swung there like a climber on a vine in a windstorm while the creature shrieked "Get it off, get it off!" and flailed with its arms and backed out of the cavern.

The other creature was just outside, already reaching for its numbing weapon. There was no way she could kill this one in time to attack the other before it weakened her again. Instinct chose her next action: she wrapped her hindlegs around the smaller creature's neck, stuck the tip of the knife against a soft spot at the base of its skull, and snarled the short, blunt word that meant "Stop!" to every creature in the world.

These two both froze. Then the big one said, "Holy shit, it's intelligent."

"I don't care what it is, get it off me!" said the other. It was the voice that had been speaking into the big one's ear before.

"It's got a scalpel. Don't do anything sudden. You too, little guy. Relax. We're not going to hurt you."

It was speaking to her, that much was obvious, but its words were garbled. Both of these creatures spoke a language that wasn't in her ancestral memory. But that was impossible. Surely, sometime during the evolution of their language, someone would have learned it and escaped. Even if the language evolved further afterward, *some* of the words would be understandable.

Its intent was clear enough. It meant to keep her from killing its mate until they could overpower her. She couldn't give them time enough to make a plan. She tightened her grip on the smaller one's neck and said, "Take me out of here," jerking her head sideways to emphasize her words in case these new creatures couldn't understand her, either.

"We're sorry," the big one said. "We really didn't know." Its voice sounded conciliatory, but she barked "Stop!" again and it shut up. It could be conspiring with the other one in their private language.

"Move," she said, jerking her head sideways again. She would have pointed, but she couldn't lower the knife, and she didn't want to risk letting go with her other paw, either. They had to know what she wanted anyway; what else could a former captive with a knife want?

The big one backed away, and the small one moved after it, carrying her on its shoulders. They moved down a narrow passage, turned left at a fork, and started climbing a set of regularly spaced ledges. As they climbed, she realized that she was getting lighter. It felt as if she were slowly being immersed in water until she floated, but there was no water, and none of the hungry creatures that lived there.

She dug into the smaller creature's loose skin with her claws and held the knife against its neck. At the top of the ledges, her weight was entirely gone, and the creatures floated into another cavern where finally a familiar sight greeted her. It was only recently familiar, but the silver egg resting in the center of the cavern was a relief after so many unknowns.

The big creature pointed at the egg. "You've got to get back in there if we're

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going to take you home."

Perhaps to illustrate what it meant, it climbed inside and pushed itself downward until it sat in a close-fitting niche surrounded with blinking lights and various protrusions. It patted the artificial ground beside it, a clear invitation for her to join it.

Should she do it? *Could* she do it? There was no room for the second creature inside the egg. She would have to let it go if she were to climb inside with the big one. She gauged the distance between them and prepared to leap, but in her momentary distraction she had forgotten that the creature she held hostage was not tied. While her attention was on the other one, it simply reached up and snatched the knife from her paw.

She leaped before the little one could use the knife. The big one yelped and grabbed for its numbing weapon, but she bit its forepaw, crunching down until she felt bones break, and snatched up the weapon when it spun away from the creature's grasp.

She had seen how the weapon worked. Grab it here, put a claw here, and squeeze. She aimed it at the lower half of the big creature and tried it, and was gratified to see its legs slacken.

She clutched the big creature's shoulder and held the end of the weapon to the side of its head. "Take me home," she said, but the creature was yowling and paying more attention to its broken forepaw than to her.

The smaller one advanced with the knife, but she growled "Stop!" at it and it paused, its eyes shifting to her and then back to the other creature.

The big creature bent forward to cradle its wounded paw against its belly. A normal enough response to injury, but it could easily have another weapon tucked away, too. She slapped its paw with her tail, and when it flailed outward in pain, she shot the paw with the numbing weapon.

"There," she said. "Now it doesn't hurt."

The big creature looked at its paw, then at her, then at its paw again. It let out a long breath and said, "This guy's scary fast, mentally as well as physically. We really don't want a bunch of them pissed off at us."

"You can't fly like that!" the smaller one said.

"It's all right," the big one replied. "The landing site's programmed in. I'll drop it off and be right back. Get the docbox ready for surgery."

She let them have their parting words, whatever they meant. It didn't matter now. She held the big creature's weapon. If either of them tried anything, she would weaken them both with it and eat one of them while the other watched.

They seemed to understand the situation. The small one lowered the knife and floated back. The big one said, "Okay, little buddy, don't panic when the door closes," and it reached slowly forward with its good paw to touch one of the raised bumps on the shelf before it.

The egg sealed itself with a piece of shell that slid down from above. The interior grew darker, but light still streamed in through the clear part of the egg in front of the creature.

"Are you out of the docking bay?" it said, and the smaller one's voice said in its ear, "Clear. Be careful."

It touched more of the bumps before it, and the wall of the cavern slid aside just beyond the egg. Outside was an arc of brilliant white cloud, swirled like foam in an eddy, with a sharp line dividing it from blackest black above.

The egg lurched, then slid out of the cavern into the darkness. It tipped until more cloud was visible, cloud and sky and ocean and ground all mixed together.

"Beautiful, isn't it?" the creature said. "That's your world."

She let it talk, even though she couldn't understand its words, or the

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sight beyond the egg. She kept her eyes on its paws, watching what it did with the bumps and the blinking lights before it.

"Get ready for thrust," it said, and when it pushed one of the bumps, she felt her weight return. She teetered on the creature's shoulder, but wrapped an arm around its neck and held on.

The clouds and sky and ground grew nearer, and then the egg started to shudder. She heard the sound of wind rushing past, and not long after that the clouds and sky began to separate from the ground and the ocean, and she realized that she had been above them all, and was now descending through the sky to the ground. She had no knowledge of any creature that could fly that high.

She watched this one's every move. Every time he pushed that bump, the egg veered left. The bump beside it made the egg veer right. Other bumps controlled up and down and forward and back. She committed them all to memory.

The ground came up toward them, and she saw that they were dropping toward a bay, probably the bay where she had hatched. After all this, the creature was going to lay the egg on the sand again, and make her climb the cliffs herself.

"There," she said, and this time she did risk pointing with the paw that didn't hold the weapon. "Go there."

"Yes, that's your home," the creature said in its unintelligible language.

"Go there," she said again, pointing.

If it understood her, it gave no sign of it. The egg fell onward, past the cliffs, slowing until it came to rest with a soft thump on the narrow strip of sand between ocean and cliff face. But the tide had risen. A wave came in and swirled around the base of the egg.

"No!" she shouted. "Go up! Up!"

"It's all right," the creature said. "You're home." It pushed another bump and the door slid upward. "Go for it, little guy," it said.

She slid off its shoulders, but not toward the door. She pushed herself as far away from it as she could, and put the creature between herself and the opening.

"It's all right," the creature said again. "I'm sorry I—"

It had just time enough to register surprise when the scaly green tentacle reached in through the door and wrapped around its neck, but the tentacle yanked it out through the door so quickly that it never even had a chance to scream.

She didn't wait for another tentacle. She leaped for the bump that controlled the door and banged her paw on it, then pushed hard on the one that made the egg go up.

The egg went up. The same mysterious force that had crushed the air out of her last time tried to do it again, but she hit the *down* bump and it eased off. She looked out the clear side of the egg as the cliff face slid past. When she was well above it, she pushed one of the bumps that made the egg go sideways.

She had intended to set it down at the top of the cliff, but as she drifted over the forest, she looked beyond the treetops to the mountains where the adults lived. She could bring it down there just as well as here and save herself the walk, and the egg would put her in a much better bargaining position when she got there. With it, she could enlist the adults' aid in hunting down and killing the rest of these new creatures before *they* became the dominant species in her world.

Her world. She remembered the view from above, seeing the whole thing at once. That could explain why she had no foreknowledge of the new creatures. If they actually lived beyond the sky, maybe they had never come here before.

No matter. If they ever did again, she—or her progeny—would know just what to do. ■

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Mia Molvray

Mia Molvray is a biologist with an interest in aliens and alien cultures. "I just love world-building," she says.

It's an interest that stems from her own background. Born in Australia and educated in Cambridge, Massachusetts, she grew up speaking Russian, not learning English until kindergarten. Stints living in Germany and Holland taught her four other languages: German, Dutch, French, and some Italian. Not to mention Latin, which she learned in high school, and Spanish, which she's now absorbing from her Southern California neighborhood.

"The multi-cultural background I've got seeps in all over the place," she says of her fiction. "It's sort of automatic."

She's also a scientist, who spent years studying the evolutionary biology of terrestrial orchids. Not that there's such a thing as alien orchids. "These live on the ground," she says. "The others live in trees."

Like a lot of *Analog* writers, she loves the outdoors. "I think slogging through rain and mud is fun," she says. "If they launched an interstellar probe and were looking for volunteers, I'd sign up in a minute."

Before she quit academia to become a full-time writer, her research taught her a great deal about what alien lifeforms might be like.

For example, she says, some orchids have flowers that, to a male wasp, look remarkably like females. They bloom slightly before the real females appear, drawing "naïve" males who spread pollen when they try to mate with the blooms.

This complex mechanism has evolved at least six separate times on two continents. Its relevance to science fiction? "We're always talking about how, 'Gee, aliens are going to be weird,'" she says. "But maybe there will be more similarities than we think. Convergent evolution happens all the time, even for very complicated things."

Like other biologists, Molvray wants to see more good, biological science fiction. "A lot of hard science fiction writers are physicists," she says, "and their knowledge of biology is pretty basic."

She'd also like to see science fiction—particularly mass-market science fiction like movies and television—make more effort to get the science right. She doesn't buy the excuse that this interferes with the story. "It makes it more believable!" she says.

"It's the Heinlein vision," she adds, "that you can use science fiction to make people interested in science. Science fiction could play a tremendous role." ■

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Low Life

Mia Molvray

Understanding observations always involves assumptions so deep that they may seem unconscious. . . .

They'll always need plumbers, Mike's dad said. He said it so often, sometimes it seemed like the only thing he'd ever said. When Mike talked about going to college, the answer was, "They'll always need plumbers." When he went to college, it was the same. But he didn't listen. He wanted to travel, go places nobody had ever seen before. You couldn't do that by fixing toilets.

College turned out to be too many books, and too few new worlds. He dropped out after two years. He'd barely stepped off the bus with no idea what to do next, when there it came again.

"They'll always need plumbers."

So he gave up and became a plumber.

"Good choice, son," said his dad for a change. "Don' matter where you are, Poughkeepsie or Pluto, you'll have a job."

Which was how it happened that when Mike shipped out for a moon of Jupiter, he went as a master plumber. He didn't go looking for new worlds. By that point, he just wanted to leave the old one behind. He almost didn't get the job because his psych profile said his wife had just left him. Personnel was worried about what they called his "stability." They would have been a lot more worried if they'd known that he'd loved her enough to let her take everything the two of them had, and then she even took his dog. Why else would he be shipping out to Jupiter?

But the biggest problem with being a plumber was that you had to deal with the same shit everywhere. His boss, for instance.

"Mike," she was saying, "ever since you've arrived, we've been having problems with contamination."

It didn't help that she had straight, floppy black hair, kind of like his wife—his ex-wife.

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"The Station hired a master plumber," she continued, "precisely to avoid this kind of problem. We're trying to find *native* life here on Europa, not *E. coli*, you know."

"Yes, ma'am."

"So what's the problem? Why can't you get a handle on this?"

"I—"

"I'm not a master plumber, but even I know that there has to be a leak in tertiary treatment somewhere, which is letting contamination through."

"Yes, ma'am."

"Look, are you taking this seriously enough?"

"I—"

"It's costing the Station thousands of dollars to sterilize every pint of waste so that we don't contaminate the whole damn moon. By next week, I want to hear that you've found the problem and dealt with it. I'm not having my department be the one hemorrhaging red ink every time the section heads meet."

"Ma'am, we should do a full genome scan—"

"For a couple thousand *more* dollars? For dead-common *E. coli?* Are you nuts?"

"No, ma'am. It could be a dangerous mutant. It—"

"Nobody's sick, so it can't be too awful. I am not spending thousands of dollars on a gold-plated study of sewage. And that's final."

"Yes, ma'am."

A pretty typical talk with a boss, as these things went. He said, "Yes, ma'am," (or, "sir") and at the end he still had a job. They never seemed to want to know what he thought was wrong, which, given that he was the guy standing in the crap, might be worth knowing.

Although, this particular time, the only thing he knew was that he didn't actually know anything. Sure, the test strips said it was *E. coli*. But test strips weren't known for their intelligence. They probed for a tiny segment of DNA, and that was all. They said nothing about how good the match was. They said nothing about all the rest of the DNA. And the rest was obviously very far from normal *E. coli* because the contamination was worst right *after* the sterilizer. On Europa, that was a clear-topped tank at the surface, which exposed the Station's water to the hard radiation up there. That killed everything. It even disintegrated the exposed equipment in a matter of months, so it had to be replaced. And yet that was where the test strips showed the contamination.

Mike was so frustrated nobody wanted to find out what was really happening that he'd even tried looking at a sample under a microscope himself. That didn't cost anything, but it didn't help either. All he could see was that there were rod-shaped bacteria in there. They could be anything. You could never tell much about bacteria by looking at them.

On the other hand, everybody who did know how to study the damn things, didn't. Nobody came all the way out to Europa to study *E. coli,* not even if it survived after every bolt and pipe was completely chlorine washed and steam cleaned. As far as everyone else was concerned—"everyone" being his boss—every time the test strips came up positive, all it meant was that Mike was a failure.

It was lunchtime. He wasn't hungry after that little chat with the boss, but if he didn't eat, he might find himself talking to a counselor. The scientists could skip meals and work late, but plain workers were supposed to lead "balanced" lives or management wanted to know the reason why. His crew was all sitting together at one table in the canteen as usual, since doing anything else meant sitting at a table full of scientists or secretaries. Almost everyone was there. Blond, chubby Jessica; the craggy-faced old guy; and,

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of course, Artie Ahearn. The guy who'd assumed he was going to be foreman until Mike was hired over him. The one free chair would have to be next to him. He was a gangling, red-haired fellow with, at this point, ketchup all over one side of his mouth.

He interrupted his chewing to say, "That was the boss lady pagin' you again, Mikey."

"Yup."

"Seems to want to see a lot of you," said the guy with a grin.

Mike wondered whether to tell him what he looked like, grinning with his mouth full. But being foreman meant that there was lots of stuff Mike couldn't do. At least, that's what it meant to him. "You take care of your work, Hernie, and I'll take care of mine," he said instead. He knew Ahearn hated being called "Hernie."

"Hey, mate, I thought you said we're all in this together." The man grinned again.

He tended to go back to his Australian roots when he was madder than usual.

"Well, we will be," said Mike. "We'll all be in the same ship headed back to Earth if this contamination problem isn't sorted out. Which might not be such a bad thing."

"It's nothin' to do with me," said Ahearn immediately. "It started three months ago."

That was when Mike arrived. The guy never missed a chance to point that out.

"The rest of us," Ahearn was going on, "worked with an old hand here for months at first. You learn all sortsa tips and tricks."

Mike felt like saying, *"Aw. You're depressed you couldn't spend more time with me, teaching me how to keep shit out of drinking water. I'm touched."* But he managed to keep his mouth shut long enough for someone else to start talking, and the moment passed. One of these days it might not.

"Might just be the Station getting old," said the veteran of many space stations, practically right back to the first one ever built.

"Old!" piped up Jessica. "This one was built five years ago! And it's not like we've been slouches maintaining it."

She'd been there right from the start, and nobody was going to tell her she'd been doing a bad job, no matter how many stations he'd worked on.

"You can take care of it like the family jewels," the veteran argued. "That's not the point. It's the hard radiation. The seals give out. You shoulda seen the moon base after two years. Dust everywhere."

"I still say we oughta look at what changed three months ago," Ahearn said again. "New policies, all that stuff."

"Christ on a bike, Artie;" said Jessica. "You keep tryin' to pin it to three months. Three months ago is when we started *finding* it. Nobody knows when it started. What changed three months ago was that Mike had us looking in places we didn't check before."

"Maybe messin' with the system is what gave us the contamination. Have you thought of that? I mean, sure, management likes to hear rosy scenarios, but we're tryin' to solve a problem here."

Jessica stared at her plate for a second. When she looked up, she stared just as fixedly at Ahearn.

"Well, here's another thing to think of. We've chlorinated, like, five times since we found the stuff. It keeps reappearing. Almost like someone's putting it there."

"What are you sayin'?" demanded Ahearn.

"I'm not sayin' any more than you are with your 'three months' all the time."

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Mike could see Ahearn get livid. Literally. His red complexion went white around his mouth, and his lips peeled back from his teeth in a vicious grin.

"You sure work hard at tryin' to get the easy jobs." His glance flicked at Mike.

Jessica carefully separated out the recyclables and the dishes on her brown tray, even though she hadn't eaten all of her lunch.

She stood up. "You got ketchup all over your face, Hernie," she said.

He touched his face before he could stop himself, and Mike almost laughed.

Jessica was all the way across the canteen and cleaning off her tray before anyone said anything.

Mike leaned back in his chair and looked at the man, who was using his napkin for the first time. "Artie Ahearn," he said, being all formal to tell him that this was his foreman speaking and not pushover Mikey. "You said it yourself. I think we're in this together. So when I give out the scut work, I give some to everybody, including me. But I could do the assignments the way they do them back on Earth. Based on length of service as a journeyman." Ahearn was the most recent hire on Mike's crew, except for Mike himself, who hadn't been a mere journeyman in years.

The man got whiter around the mouth, but didn't say anything.

Mike didn't say anything either. He was busy wondering just how far Hernia-boy was willing to go to make him look bad. And if it was far enough to be actual sabotage, he'd better start watching his back with every ounce of smarts that he had, because Ahearn was always damn good at what he did. There was a reason why he thought he was going to be the next foreman.

Sabotage made a lot of sense, now that Jessica had mentioned it. It was probably the only thing that could explain the way the stuff kept showing up where it shouldn't. He ought to have thought of it himself, except he never did. He always assumed people would treat him the way he treated them . . . and then wound up wondering why he was shipping out to Jupiter with one suitcase to his name.

Of course, if he was going to start being suspicious, to be fair he had to be suspicious of everybody. Including, for instance, Jessica. She had a face like a cherub, and had shown him all over the Station when he arrived. She was always helpful. She didn't look like a plumber, which was also nice. And she was carrying a difficult past, just like him. There was something to do with her family and a stepfather she didn't talk about.

But a pleasant manner didn't mean a thing. It wouldn't be the first time he'd been successfully lied to. And everybody who wound up here, in the Foreignest of Legions, had something they were leaving behind. Even Ahearn. His personnel record had one line noting that his wife had died in a traffic accident.

What it came down to, thought Mike, was that he just didn't know. If it was accidental contamination, he had no idea how it was happening. If it was sabotage, he knew even less. Except that in that case, there were ways to find out more.

He set the whole crew to sterilizing everything one more time. The water system would have to be shut down and flushed. There were groans everywhere. There were even groans over the PA system.

Then, by himself, when he was sure nobody was watching, he rigged up three of the tiny robot cams normally used to inspect blocked pipes. If somebody really was contaminating the pipes on purpose, that somebody was going to jail.

"What are the robocams for?" Jessica asked the next day.

Mike said nothing. He didn't have

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any quick excuse handy. He hadn't realized he was going to need one.

She started looking embarrassed. "Uh, it's no big deal. I was just curious. I happened to notice that you were in the pipe closet when I was on my way to my dorm. Um . . ."

She trailed off, looked at the floor, and then at a console near the wall.

Mike's first thought was, *Why the hell is she following me around, keeping an eye on me?* His second thought was that she wouldn't be letting him know she'd noticed if she had a guilty conscience.

"Anyway," she continued, "I just wondered if Ahearn is supposed to be doing a surface check. 'Cause he's up there."

"Checking the outside of the sterilizer tanks, you mean?"

She nodded.

Mike went over to the terminal by the wall, and called up his duty rosters. "I thought so. He's supposed to be doing that two weeks from now."

He stared at the console and thought. He could call the man's suit radio and ask what the hell he was doing, but if he was up to no good, the direct approach wouldn't achieve anything and it would let him know he was being watched.

If Hernia-boy was taking secret trips to the surface, and somehow introducing contaminants into the sterilizer tanks from the outside, that would explain a lot. Mike had better get himself up there immediately and follow Ahearn's footsteps, testing for *E. coli* the whole way, before the hard radiation had time to disintegrate everything to its component atoms.

"Okay," said Mike. "His suit coordinates say he was at tank four." He opened a cabinet and pulled out a completely new test kit. "We just sterilized everything. Let's go see what we find. I'd like you to be there to document everything I do."

Jessica acquired a look of grim, uncherubic satisfaction.

"You really don't like the guy, do you?" said Mike as they walked toward tank four.

She blushed furiously and didn't say anything. Gradually the red receded, although she still had a suffused, fixed look. It was funny, thought Mike, how that look marked a blush even on people who didn't turn visibly red, such as black people like himself. It was almost as if the mind's eye could detect infrared.

She finally spoke, now that she had a hold of herself and was almost back to her normal pink. "It's not that at all. I'm just trying to help."

"Hey, don't get me wrong. I think you're far from alone when it comes to Ahearn."

"Yeah. Right." She still looked furious, and she was turning red again. "I'm probably alone in him propositioning me, though, first chance he got."

"Say what?"

"Just what I said."

"That's against every rule in the book. If you want to complain about him, I'll back you all the way. *And* I'll read him the riot act."

Jessica grinned without any humor. "You don't like the fellow much either, eh?"

Mike skipped a beat, then said, "It's not that at all. I'm just trying to help."

Her smile became genuine for a heartbeat, and vanished. "What I really want is to turn him into mincemeat myself. But he just grins down at me from up near the ceiling and acts like I'm nobody."

They'd reached tank four, and Mike knelt down to open the kit and start the testing procedure. He told her to turn on her comm's camera, and sat back while the test strips took their minute to show a reaction.

"You know," he said, "he may have hit on you, but he can't stand you. You have achieved that."

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Jessica glanced at him, surprised, and smiled as she looked away. This time the smile stayed there.

Then the kit beeped, and Mike pulled out the test strip, and they both stared.

Positive.

"Okay. Out to the surface. Double quick. Before every trace of the stuff degrades. Where's Hernia-boy?" Mike checked his whereabouts. "In the suit storage room. So he's down and out. Let's go."

Following the exact path Ahearn had taken, they reached a spot right at the edge of the top side of tank four where the infrared signature of escaping heat gave off a faint glow on the scanner, indicating a breach in the tank's hull. And all around the leak, trampled into the dirty surface ice, were still traces of *E. coli*.

Mike stood in the boss's office, feeling jumpy. It wasn't the first time he'd had to report on a firing offense, but it always made him feel bad. By way of easing into it, he said Ahearn had taken an unscheduled trip to the surface.

"Yes," said the boss. "He just reported to me, barely half an hour ago that there was a leak up there."

"He did?" Why in hell was he reporting something that would allow the sabotage to be traced to him? And why wasn't the boss wondering that it hadn't been reported to Mike, as it normally should have been? "Did he also mention that after he'd been there, *E. coli* contamination showed up in tank four and around the hull breach?"

"What?"

Mike explained exactly what he'd done.

The boss pushed a button on her intercom. "Mr. Ahearn? Come to my office, please. As quickly as is compatible with safety."

That was spacespeak for "Get your butt in here instantly."

He appeared in less than a minute by the wall clock, looking worried.

The boss said without any preamble, "Apparently, there was something you overlooked in your earlier report. *E. coli* contamination followed your activities. Can you explain that?"

"What? What're you sayin', m-ma'am?" demanded Ahearn.

"Contamination was found in tank four, after you were busy with it at the surface. And a subsequent check of the surface found contamination there, too. Careless work," she said, narrow eyed. "You could have at least not spilled it all over everywhere."

"But, but I didn't! I was up there checkin' for leaks. Old Jim mentioned leaks at lunch, and that area around tank four has been lookin' strange to me for weeks—something about the way the ice there looks, grayer, or something—so I thought I'd go up and check. And there *was* a damn leak. I didn't do anything but look for it. I didn't spill anything. I didn't do anything but look for it!"

Suddenly he turned on Mike. "And I suppose you found all this contamination."

The next thing he was going to say hit Mike like a brick. *I bet you put it there*. Of course. This was the man's frame. Why hadn't he thought of that? But what Hernia-boy didn't know was that Jessica had documented every step Mike took.

"Well, good for you," said Ahearn. "Now all you gotta do is find out who did it, because it wasn't me."

"And who do you suggest?" said Mike. "Nobody's been up there in days, except you. The tanks were sterilized yesterday, and minutes after you're up there, *E. coli* shows up."

"How should I know who did it? If I was going to do something like that, I sure as hell wouldn't sign out a suit, all legal and proper, and then do it while I had the transponder and locator going full blast."

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True, thought Mike. That didn't make a lot of sense. Besides, now if anyone pointed out that there was no record of Mike being up there, it would be proof of guilt rather than innocence.

"You want to find out who did it, go test every arse on the Station."

"That wouldn't be any use, Mr. Ahearn." The boss didn't look like she believed a word he said. "The test strips ID it as one of the commonest strains. Everybody on this Station probably has it. Including you."

"It wasn't me, I tell you! Hell, he's just throwin' this out, trying to see what'll stick to the wall. Where's the container I'm supposed to have carried the stuff around in? Where's the new water ice where I supposedly spilled everything? Huh? Where is it?" He turned on Mike again. "He's just tryin' to put it on me to save his own job."

Hernia-boy. Always the charmer, thought Mike. But some of what he said was true: finding him together with *E. coli* was not the same as finding him causing it.

Although it sure felt like a "beyond a reasonable doubt" situation.

But it didn't feel like a frame. If it was one, then why wasn't Hernie framing? He was just yelling that it wasn't him with the desperate conviction of a man without an alibi. It would make a lot more sense to have an elaborate lie ready, if he was really guilty.

It wasn't fair to fire someone just because he couldn't prove he was innocent.

"Ma'am," said Mike, "he does have a point. It looks bad, but there isn't any proof. We should make sure we know what we're dealing with, one hundred percent, before taking other steps."

"We do know what we're dealing with," said the boss. "*E. coli* in the sterilizer. And I, for one, have had enough of dealing with it. I'll need your signature and thumb scan, Mike, on the form stating the facts in the case."

But Mike was no longer happy with the facts in the case. One of his workers was on the line, and there were too many things that didn't fit, especially the fact that Ahearn was just making helpless assertions nobody would believe.

Mike departed from the policy of a lifetime. "No, ma'am," he said. "I'm sorry, but I can't do that until we actually have all the facts in the case. I feel very strongly that we must have proof before one of my crew gets terminated."

"Mike Warner, are you seriously telling me you want this department to pay thousands of credits for the microarray scans station enforcement will require to prove exact matches between this contamination and whatever they find after searching Mr. Ahearn's effects? All just to reach the obvious conclusion?"

"When it's obvious, I'll sign the forms. Right now, I think Ahearn has valid objections."

"Mike, with all the extra costs of the contamination—which has happened on your watch, I might add—this department is so over budget, I'll be lucky if *I* don't wind up having a little chat with the head of Support Services in Geneva. Scans will push us right over the edge. If it was actually necessary, I wouldn't hesitate, of course, but this is just a waste."

Mike looked at his feet, set his mouth, and replied. "Ma'am, unless we have proof, I'll support Mr. Ahearn if he applies to the union for legal representation to sue for wrongful dismissal."

There was silence. The boss stared at him. Out of the corner of his eye, he could see Hernie staring at him with his mouth open. It didn't improve his looks.

The boss's eyes narrowed. Always a

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bad sign.

"Well, if you feel that strongly about it, that's your right, of course. However, the whole Department will have to economize to make up for the added costs. There won't be enough money for any discretionary items. Like private quarters for upper-level staff." She was looking at Mike. "You're sure you feel all that expense is necessary?"

Mike looked at his boots again. Man, she sure didn't want to talk to anyone in Geneva. . . . And he sure didn't want to lose his one little bit of privacy for the sake of Hernie "Charming" Ahearn. . . . On the other hand, he did want to be able to face himself in the mirror. He tried to think fast.

"How about if I tried to make the case a bit more solid before we have to spend money on lab work? Enforcement would want us to prove that the contaminant, and what's on the space suit boots, and whatever they decide needs testing in his personal stuff is all the exact same thing. I've actually done a couple of full microarray genome scans—"

The boss interrupted, looking incredulous, "And when—oh, wait, they take you through that in the advanced certification for work on space stations, don't they? Part of the versatility training, I believe."

"Yes, ma'am. It was just one of the simple kits, where we had to add solution A to solution B, and that kind of thing. But I could look up exactly how to do it, and assuming we have that kind of kit on the Station, then I could try to take a look. It would tell us whether there's enough of a match for it to be worth paying a tech to do it officially. I assume the cost of the tech is the most expensive part."

"It won't save much on hourly wages, unless you do it on your own time."

"I'll do that, ma'am," he said, feeling tired. "I'll do it on my own time."

"You know, Mike, you've been pushing for a full scan since day one. Tell me this whole thing isn't an elaborate setup to get what you want."

"No, ma'am." He was pretty sure she'd actually made a joke there, but it was hard to know with her.

"Well, one more thing, then. Why should I believe your results? Aren't you an interested party?"

"Because I'd believe them. Ma'am." Ahearn spoke suddenly.

"Mrm," she muttered in noncommittal assent. Then she took a breath that was louder than it needed to be. She pushed another button on her intercom. Soon she was talking to the law.

"All right," she said, pushing the disconnect button, "they've impounded the suit he used. You'll be wearing a legalcam once you take samples from it and until you get me your results. An officer will be here momentarily to attach a cam to you, too, Mr. Ahearn, following the usual procedure."

She pushed another button. "Hang on a second, Mike, and I'll see if I can't get us a spare microarray from one of the bigger labs. That way there won't be any real expense at all, and we won't have to worry about economizing." She smiled thinly.

It was the first time Mike had ever seen her extend herself to help. Was this her way of saying she saw his point?

"So?" said Jessica, pouncing on Mike before he even reached the canteen.

"So, I'm gonna eat dinner," he said, a bit surprised.

"I mean, so what's going to happen with Ahearn?"

"Oh. Nothing yet. First we have to show he's guilty."

"Show he's— I don't get it."

Mike explained. "And," he wound up, "I get to spend all night trying to remember how to do this stuff."

Jessica looked glum. "We're never

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going to get rid of him, are we?"

"We may not."

She looked glummer.

"I haven't had anything to eat since breakfast," he said. "If you want to watch me eat, we can discuss what to do about Hernie as far as you're concerned."

She trailed after him, not looking too thrilled.

"I, uh, didn't mean you *had* to. Whatever works for you."

She started getting redder, until she was the color of one of the better class of tomatoes.

"Whatever works," he repeated a bit desperately, wondering what to say to keep himself out of trouble.

"It's," she said, looking at the floor and the walls and far down the hallway, "it's not that. It's . . . I'd . . . like . . . to go to the canteen. I just don't want to waste the time talking about Herniaboy."

Mike stared at her for a second. Then he remembered that his w—ex-wife always had said that he was slow.

He had no idea what to say next. *How long have you felt that way?* No. *I'm glad to hear it?* Also not. *What do you want to do about it?* Definitely not. Although he'd really like to know.

She was still bright red, but as she looked at him looking at her, she started to smile.

That, he could deal with. He started to smile back.

"I guess you're going to be pretty busy with all this stuff the next few days, huh?" she said.

Busy? He liked the sound of—wait, she didn't mean that stuff, she meant the Ahearn stuff. He'd forgotten all about the Ahearn stuff. Life was really asking a bit much of him, if he was supposed to waste time on that now.

"I could probably help," she said. "I mean, I do know how to read directions, and I took the basic Station certification. We did some lab work in that for advanced water quality testing."

"Jessica," he said, beaming, "that's really nice of you." That was the one thing that could make messing with microarrays bearable. That was . . . Or was she just trying to get close enough to the samples to make sure they gave the results she wanted? Couldn't be. Or could it? "Uh, look, I'm not sure how to say this, but, given how you feel about Hernie, are you sure you want to help?"

She started to glower.

"How'm I supposed to take that?" she said. "If you mean, do I want to help Ahearn, then no, of course not. If you mean, will I try to fake the results instead of helping, well, then . . ." For someone with such a cherubic face, she had quite a glower. "I do know the difference between doing what's right and doing what I want, you know."

"Jessica, I— They'll probably make you wear a legalcam."

"Right. So?"

The hour was nearing midnight. Even the graduate students had left the lab where Mike and Jessica had been allowed to work. The samples were still waiting. Jessica began flowcharting protocols. Mike was still plowing through old files from his courses, then checking twenty screens' worth of instructions. He remembered too clearly why it was that he'd dropped out of college.

Then, a couple of hours after that, they finally had their first result, taken from the sterilizer tank. They both leaned in toward the computer screen—and Mike realized he was too tired to even notice the feel of her at first. Man, Ahearn was really going to have a lot to answer for when he was finally done with this nonsense. Which should be soon now.

The results scrolled up.

They matched nothing. Absolutely nothing. Not *E. coli*, not eagles, and not earwigs. Not any living thing.

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Mike groaned.

"Oh, hell," muttered Jessica. "We screwed up somewhere." After a minute, she said, "Well, come on. We have to redo it. The sooner we get started, the sooner we'll be done."

"You have got to be kidding."

"Do you want the answer or don't you?"

"I want the answer, all right. I just don't want to do the work to get it."

"Yeah." She grinned a bit. "I know just how you feel."

An hour later—they were getting better at it with practice—the results scrolled up again. This time they'd tried the sample off the spacesuit boots. But again, the results matched nothing in the world. Except they did match the previous ones.

"Mike, look at that. It says there's a hundred percent match between the two samples. But no match to anything else. How is that possible?"

How indeed?

"The only way to do that is if we got a real result the first time, and the same one second time around. If it was a mistake, we couldn't get the exact same mistake twice."

"What are we looking at here? The water tank or the stuff off his boots?"

"Both. Number one was water, number two was boots." Then he had a dreadful thought. What if the samples had somehow been switched, and they'd been working on distilled water or something the whole time? Although that should have led to no data rather than bad data. He found some of the regular test strips and dipped those in.

They came up positive for *E. coli*.

Either they were wrong or the microarray that looked at the whole genome was wrong. The microarray couldn't be wrong. The test strips were being fooled by . . . by what?

By a one in ten billion chance match with a tiny little stretch of DNA. By life that was right off scale, hiding in plain sight because it was camouflaged by a cheap test strip. Hiding in plain sight out on the surface where everyone knew nothing could survive, instead of being deep in the ocean where everyone was looking for it.

He looked at Jessica. She looked at him.

"What's that expression of yours? Christ on a bike . . . We've found life on Europa. Now all we have to do is find a scientist who's willing to listen to a couple of plumbers." ■

Thinking is the hardest work there is, which is the probable reason so few engage in it.

—Henry Ford

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A Deadly Intent

Richard A. Lovett &
Mark Niemann-Ross

Illustration by Nicholas Jainschigg

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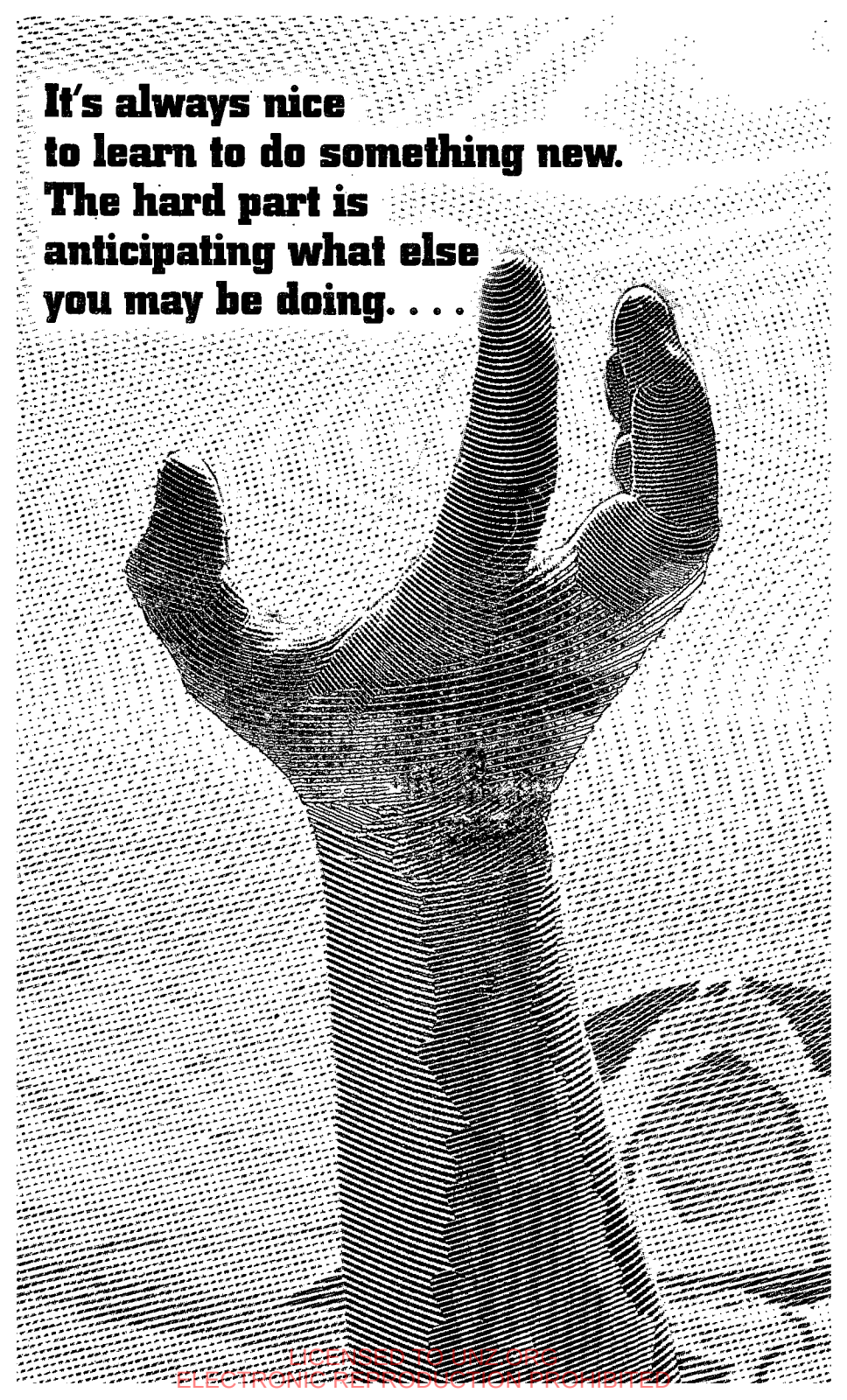
It's always nice to learn to do something new. The hard part is anticipating what else you may be doing. . . .



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There's an ineffable something about a frozen corpse. And sadly, if you hang around high elevations and the Antarctic as much as I have, you eventually see a few.

Not that this stopped me from dropping my pack, yelling Courtney's name, and running to her. It's called denial. Your hindbrain figures that if you act quickly enough, maybe you can roll back the clock and stop the disaster that's already happened. Your conscious knows better, but for the moment it's just along for the ride.

She was sprawled facedown in the snow, wearing nothing but turquoise panties, about a dozen feet from her tent. If there was any doubt she was frozen, it was dispelled when, ignoring the fact it was fifty degrees below zero and blowing like a bitch, I stripped off my gloves and reached out to take her pulse. Her arm was unbendable, and not from rigor mortis. That doesn't exist at minus fifty. If you die without a thermal suit, you freeze solid long before rigor can set in.

There was just one other thing wrong: Courtney Brandt was warm to the touch. Which was truly bizarre because she was so solidly frozen I couldn't depress her skin enough to have found a pulse if there'd been one to find. But even though the wind was rapidly sucking the heat from my hands, she was most emphatically warm. Nice, toasty, body-temperature warm. Feverishly so, in fact.

Weirder yet, a Courtney-shaped depression indicated that even as she was freezing to death, she'd been generating enough heat to melt into the snow, while I'd been off with other clients on the Vinson Massif.

If you've not heard of it, the Massif is the highest point in Antarctica. Sixteen thousand feet of wind, glacier, and why-the-hell-am-I-doing-this slogging. Except I knew why, because I'm paid by NanoSport Systems to help take average-Joe-and-Jane tourists on adventures proving NanoSport gear can keep you comfortable under any conditions, even on a late-season climb only seven hundred fifty miles from the South Pole.

Which means that Courtney was absolutely not supposed to die this way. Not to mention that she was one of the world's true innocents and didn't deserve it. She was a twenty-seven-year-old florist who'd won a slot on the trip by writing two hundred gushy words on why she wanted to go to Antarctica. So what if there aren't any penguins at sixteen thousand feet? She'd been the lucky one who won the draw, and NanoSport's whole shtick was that our DaemonGear can take any reasonably fit person anywhere on the planet. You might fall off the mountain, but by golly you'd be warm and comfy when you hit bottom.

Courtney had even programmed her tent to play Pachelbel's Canon as her wakeup music. People like that aren't supposed to die on vacation. Especially on a promotional trip where the Pachelbel tent was one of the products we were planning to launch next year—though with a lot of other music options.

Of course, my reaction on finding Courtney wasn't quite as calm as all that. I've read *At the Mountains of Madness*. Lovecraft's Antarctic creepy-crawlies lived underground and didn't flash-freeze young women into too-warm corpses, but for those of us who guide down here, reading that book is like chanting, "Who has my golden arm?" around campfires in the Midwest. Spooking yourself is one of life's great pleasures if there's no chance it's real. Death is real. As for spooky death? Let's just say there were cold fingers running up and down my spine that NanoSport's best could do nothing to dispel.

The only reason Courtney had been alone in camp was that our senior guide had taken a fall three days ago, laying out monofilament line on the Headwall.

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He survived, but spiked himself good with his crampons. We'd patched him up well enough to stop the bleeding, but he'd barely been able to walk back to camp and had to be 'coptered out.

These expeditions are (supposedly) safe for the tourists because the clients don't step out of camp without clipping into the lines—even to go to the toilet. And if you think that's silly, you've never seen an Antarctic ground blizzard.

But for those of us who lay out the lines, these trips are as risky as a real climb—not to mention a hell of a lot more work.

Anyway, the accident left us one guide short. Not that I'm technically a guide. I'm the equipment rep: everyone's best friend, the giver of schwag, the guy who's oh-so-happy to hear all the details of those little "expeditions" that qualified you for our promotional tour. Hell, if you can climb a thousand meters on a health club stair-climber, you're qualified. Even in weather like this, getting to the top is just a grunt. The only difference from the stair-climber is the view.

Until, that is, Vince bit it on the Headwall. That meant there was no one to turn back with Courtney today, when it became clear she hadn't put in the health-club training to get to the top of sixteen-thousand-plus feet of snow and ice.

Not that she should have had any problem on her own. Clipped into the line, she should have gotten back to camp just fine—which apparently she had. Whatever killed her happened *after* she'd gotten here.

Better for me if she'd wandered off looking for penguins and tobogganed two thousand feet down the Headwall. Once she reached camp, Courtney Brandt should *not* have died.

My suit was warm, but my hands weren't. Besides, it was going to be really bad for morale to leave her lying here, virtually naked, in the snow. In fact, Marisa was already edging up behind me.

"Is she . . . ?"

"Yes." There have been some remarkable recoveries from hypothermia, but frozen solid is a different story. I had no clue what to make of her weirdly warm skin; but exposed to the wind like that, she had to be dead.

I glanced at Marisa. She'd been one of Vince's charges, who I'd inherited in the reshuffle because she was the fittest and least likely to be trouble. Thirty-something and built like a soccer player—short but powerful—she'd cruised up the peak with me after Courtney turned back, almost as though on a Sunday stroll. Hopefully she also had the kind of toughness I needed now.

"Can you help?"

She nodded.

I pulled my gloves back on and grabbed Courtney's shoulders, while Marisa took her legs. I didn't have to tell her where we were going. On the Massif, you do everything you can in a tent.

Of course, the tent might be just as cold inside as we were on the outside. The new DaemonBots drank power, and with the sun rapidly going north for the winter, solar power just wasn't what it could be, so I'd asked Courtney and the others to dial back their thermostats before we left. The tech folks back home weren't going to like it, but they were going to have to do something about that tent's power consumption.

Figuring out things like that was the one of the reasons I was here. The DaemonBots are nanites that control temperature by kicking fast-moving "hot" molecules in, while keeping slow-moving "cold" ones out. The name has something to do with a guy named Maxwell, who didn't really believe it could be done. But the older-generation nanites in my climbing suit were so efficient they could be powered from my own exertions, via piezoelectric threads.

Unfortunately, you can get cold spots

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when entire clusters of bots malfunction or power threads break. The new design cures that with special, mobile bots programmed to find and fill the gaps, with occasional side trips to power threads when they needed to recharge. Very slick, and likely to make a strong impression with the defense buyers. And it probably works just fine around those Midwestern campfires. Down here, though, the damn things scurry from one side of the tent to the other each time the wind shifts. A minor programming error, I'm sure, but a big power drain.

As it turned out, the power was on, though the warmth didn't last long. Dragging a frozen body into a tent is hard work, and all the warm air puffed out as Marisa and I struggled to get Courtney inside. In life, she'd been petite and vivacious. In death, she was a 120-pound lump. Her legs were as unbendable as her arms, and the tent entrance was narrow enough to make the task even more difficult.

Huffing and grunting, we'd gotten her into the vestibule and partway into the tent when Marisa kicked something that clattered behind her.

There aren't many things that should clatter in a tent. In this case, she'd nearly knocked over a stove on which sat a small titanium pot.

Cooking in a tent is a very bad idea, just because of the risk of this type of accident. That's one of the reasons mountain tents have vestibules: to give you a safe place to cook. Some expeditions also have dedicated cooking tents, with wood floors, dining tables, and propane heaters, but NanoSport isn't into that kind of gear; we only do lightweight backpacking-style equipment.

Luckily, the tent's computer—which was a lot smarter than the new nanites—hadn't allowed the stove to drain the solar batteries too far by running indefinitely at high power. Otherwise, Marisa might have scalded herself.

The lukewarm liquid she'd slopped out of the pot had a familiar aroma. Marisa pulled off a glove to move the pot and stove out of the way, then touched a finger to her lips. "Chicken soup," she said.

Way too many homey connotations for Courtney's last meal.

The tent was a mess. Normally, Courtney was meticulous to the point of being fussy, but now, her sleeping bag was shoved into the foot of the tent and clothes were strewn in random wads. It was surprising that the stove hadn't been knocked over before Marisa'd had a chance to kick it. The tent's touchscreen bore an unfinished sat-message beginning, "Dear Mom and Dad."

"Was she attacked?" Marisa asked.

I tried not to think of Lovecraft. "By whom?"

"I don't know. Were there any tracks?"

I shrugged. Dragging Courtney out into the snow to freeze would definitely leave tracks, but when the wind didn't erase them, the camp was littered with tracks. Unless they had claws or were the size of manhole covers, nobody would notice.

We wrestled her the rest of the way inside, then knelt beside her. Warm or not, her skin showed the pale death of frostbite. Even her torso was frozen solid. I rolled her over, looking for signs of violence, but found nothing. Then, Marisa tossed a jacket over her. Courtney had been a bit naïve, but she'd also been a truly nice person, and it seemed criminal to invade what little was left of her privacy.

"Could you get us some more heat?" I asked. Courtney must have liked to keep her tent cool, because with two of us in here generating lots of "hot" molecules for the bots to play with, it should have been warming up a lot faster.

"Sure." Marisa ran a finger down the tent's autoseal flap to make sure it had fully closed behind us, then turned to the tent computer. She seemed glad of

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having something to do. "How warm?"

"Doesn't matter." I was trying to examine Courtney's head, pushing the blond hair aside to look for blood or bruises. My gloves made it slow going. "We'll turn it back down when we leave." I didn't need to say *so she doesn't thaw*. That was another horror story. Something about Antarctica must generate them.

Ten minutes later, the tent was room-temperature-warm and I was sure that whatever had happened to Courtney hadn't left a mark. I'd been kind of hoping she'd somehow bashed her head and concussed herself. I'd once been on a climb in Patagonia where someone did that; waking up, he'd tried to walk home—a problem because "home" had been Florida.

Suicide? The thought made me shudder. If I had to go, I'd rather toboggan off the Headwall.

The wind was picking up and we'd accidentally loosened a couple of tent stays in our efforts to get Courtney inside. The result was a nasty flapping that made it hard to think.

"I can deal with that," Marisa said, making a rapid enough exit that only half of the now-warm air disappeared with her. As clients go, she was several cuts above the norm. Most would have expected me to be the one to go out in the cold—and the vast majority wouldn't have had a clue what to do, even if they'd been inclined to help.

Meanwhile, I scooted over to the control panel to see if Courtney's letter smacked of suicide.

"Dear Mom and Dad," it read. "I tried, but it was too tough. The view was fabulous, though, and Greg, one of the guides, was so cool when I had to go back, letting me do it by myself, as though I was a real climber, even though obviously I'm not. And, though I never got anywhere close to the top, this is the most beautiful place I've ever been. I'll never forget it, even if I live to be a hundred."

Date-stamped four hours ago, it had never been sent. But only that recently, Courtney had been very much nonsuicidal.

She also seemed remarkably solidly frozen for only four hours' exposure. At these temperatures the first touches of frostbite can hit unprotected flesh within a minute, maybe less. But the body hoards its lasts sparks of life, and to get that deeply frozen takes time. Though the lack of clothing would have sped it up considerably.

I turned back to Courtney and again touched her neck, in the irrational hope that somehow being back indoors had miraculously revived her. But other than the soft layer of skin—just as warm as it had seemed outside—the flesh beneath was rock hard.

Then Marisa was back, though getting into a tent without tracking a bunch of snow in with you is a slower process than getting out, and this time, most of the remaining warm air managed to make its exit. But I had to give her at least an A- for effort. A better grade than Courtney, for all her niceness, had managed for anything.

I didn't want Marisa to have to read Courtney's last words, so before she could knock the snow off her boots and pull her feet inside for the tent to reseal itself, I blanked the screen and opened a new panel, picking the acoustic controls because, however good a job Marisa had done with the tent stays, the wind was still making a lot of noise. I ticked on the reverse-phase acoustic damping—another power hog, but for the moment I didn't care.

The wind noise died as the sensors identified the source of the sound and used another of the tent's nifty innovations to turn the walls into a surround-sound speaker web that cut it off almost too effectively.

Perhaps it was the funeral-home atmosphere or my unwillingness to believe that Courtney had suddenly gone off her

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nut, but I was again thinking about murder. Maybe the cheery note to her parents was a forgery. Maybe she'd been smothered and dragged outside. There was certainly enough disorder in the tent to indicate that she'd been thrashing around quite a bit, shortly before the end. But why would anyone want to kill a florist? And if they did, why not wait until she got back home?

For someone to slip in and out of camp, unnoticed, they'd have to know when our group was going to be high on the mountain, where we might not notice a ski plane coming in low. That required either phenomenal luck or a compatriot to radio out the information. And even then, how would they know Courtney would be here alone?

Or maybe Courtney wasn't the target. Maybe she'd just stumbled onto the intruder. Or vice versa. That at least made sense. The Pachelbel tent wasn't the only piece of experimental equipment, and my tent computer was full of telemetry and specs that wouldn't be good for a competitor to get its hands on. The computer was secure enough that nobody could easily break into it, but literally cutting it out of the tent wall to examine back home? That was different. For that matter, was I even sure my tent was still here?

I managed not to look as panicked as I felt. "I've got to check something," I told Marisa. "Do you want to go back to your tent?"

"No." She'd been kneeling beside Courtney in an attitude that seemed almost one of prayer. Maybe it was. "It doesn't seem right to just leave her like this."

A moment later, I was out the door.

I'd nearly forgotten the wind, and I'd taken off my breath mask in the oxygen-enriched air of the tent. Now the wind and thin air sucked my breath away. Still, the oxygen wasn't any lower than on the highest peaks in the Alps, so I didn't really need assistance. I gave myself a moment to adjust, glancing around the camp and up on the Headwall. No tents were missing, and there were no dots coming down the rope from above. Marisa had truly whomped the other climbers, and we'd be the only ones in camp for at least another couple of hours. Again the cold fingers ran up and down my spine. With a murderer on the loose, the Antarctic is a very lonely place. Briefly, I wondered if it was safe to leave her, then shrugged it off. Courtney's killer had to be long gone.

Still, I picked up my ice axe from where I'd dropped it when I first ran to Courtney. *Can't let it get buried in snow,* I rationalized. But it felt reassuringly solid in my hands.

Fifteen minutes later, I was sure my data hadn't been touched. My tent looked just as I'd left it, and my computer's security files showed no signs of break-in. Maybe the murderer had blundered into Courtney's tent, looking for mine, killed her, and fled in panic. The weird way she'd frozen was probably a side effect of whatever he'd used to kill her—one that would make more sense when we got her body back to McMurdo for an autopsy.

I hadn't meant to leave Marisa alone so long, but as I crawled out of my tent, I again had to stop for my breathing to adjust. The mask and selective permeability membranes in the tent walls were a mixed blessing. Between them, they could concentrate oxygen well enough to make it feel almost like living at sea level, but that meant you never acclimated. Going outside without the mask was the high-altitude equivalent of walking out of an air-conditioned mall on a summer day. On Himalayan climbs, it's dangerous; without masks, unacclimated climbers can black out and asphyxiate in a matter of minutes. Here, it's just a nuisance.

Or is it? Courtney certainly hadn't been wearing her mask. Could her tent's membrane have broken down, leaving her wheezing and making a panicked

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run for a neighboring tent, only to collapse en route? But damn it, we weren't *that* high. And the tent had been working just fine when Marisa and I were in it. Not to mention that most people in such a situation would retain enough wits to at least grab a coat and boots.

The walk back to Courtney's tent was short enough that I'd not even gotten close to piecing together a coherent story when I was greeted by familiar sounds. Marisa had apparently also found the damping too effective, and was playing something that sounded like Courtney's favorite music. Not that it was easy to tell, from outside. The tent's speaker web is designed to optimize interior acoustics. Nobody seemed to have tested it with an ear to how it sounds from a distance. However perfect the tuning might be inside, what you heard from outside was acoustic mud, which might be okay for your local garage band, but does *not* work for Pachelbel.

I shrugged. Features sell, so the techies and marketing folks brainstorm every imaginable add-on, some of which are guaranteed to drive you crazy if you have to live with them. Unknown to the tourists, I had a reserve of tried-but-true equipment, just in case. Most of the other guides had been using it all along. Testing the latest-greatest isn't part of their job descriptions.

The wind was abating, and I could hear my boots squeaking in the snow as I approached the tent, feeling guilty about having left Marisa.

"Hi," I called. "Sorry that took so long."

I'd forgotten about the damping. The moment I touched the autoseal there was a yell, followed by a yelp and a curse.

"Greg? Is that you? Keep away if you're not. I've got a weapon."

"It's me." And she'd better not have anything nasty. Reassuring as it was, I'd parked my ice axe in the vestibule. Things like that can punch holes in the tent, and nobody's ever invented a DaemonBot that could deal with that. Still, I hoped she didn't bash me with the cooking pot the moment I stuck my head inside.

Instead, she was mopping at the floor with a piece of Courtney's cast-off clothing. "Sorry. I'm sure it sounds ghoulish, but I was starting to crash, so I made some hot chocolate. I was saving some for you, but I jumped so hard I damn near threw it all over the place. Couldn't you have at least said 'hello'?"

"I did. The damping ate it." It was yet another feature that was too damn effective. At max, it not only blocked wind noise, it squelched pretty much any other outside sounds. I stared at the stove, wondering whether to state the obvious. "Did you burn yourself?"

"Not badly." She tried to look contrite. "Sorry." She finished her mopping. "Do you want anything? I'll use the vestibule this time."

"No, thanks."

"Okay, but could you open the flap a bit? Or turn down the heat. It's awfully warm in here."

It seemed okay to me, but coming in from outside it's always hard to gauge. I shrugged and adjusted the autoseal to leave a small gap, a couple of inches from the top. Marisa was the only client who'd made any attempt to acclimate ("I want to get as much of the real experience as possible," she'd said the first time I caught her without a mask) and losing some of the oxygen-enriched air wasn't going to affect her enough to worry about.

"Thanks," she said. "Did you find anything?"

"Nothing useful." I told her my industrial-espionage theory. "If that's what happened, the guy must have stumbled over poor Courtney"—I found myself trying not to look at her body—"killed her, and run off in a panic." I paused. "Or maybe he didn't panic. Maybe he took the time to set up this weird puzzle to throw us off track."

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"So he stripped off her clothes without roughing her up, then forced her to lie down in the snow until she died?"

"Maybe he had a gun."

"I think I'd rather be shot. But maybe you're right. Why didn't he complete his mission?"

"Because if anything was missing we'd have known it was murder."

She sat back. "So he figures that we wouldn't suspect because we'd think she's weird enough to go lie down in the snow?" She pulled off her jacket and set it in a corner. "Could you open that a bit further? This place is really warm."

I adjusted the autoseal to double the size of the opening. I'd shed my own climbing jacket, and could feel a cold draft on my back, but Marisa was farther from the door.

I explained my oxygen-deprivation theory. "Maybe the murderer figured we'd think that was what happened."

"Kind of far fetched. And . . ."

"And . . . ?"

"What the hell did he do to her skin?"

"Some chemical, I guess." That was the weak link. If such a chemical existed, why would the murderer carry it unless he was planning to use it? And if he was planning it, why didn't he then rob us blind while he was at it? But if I couldn't make the murder theory work, I was back to creepy crawlies or an alien death ray.

Marisa shivered. "Maybe. It sounds awfully convoluted. Can you open that flap a bit more?"

There wasn't much left to do in the tent, and much of what we'd already done had probably been counterproductive. If it was a crime scene, between the hot chocolate and crawling all over everything, we'd certainly made a mess of it. But before leaving, I decided to search Courtney's belongings. Thinking about chemicals had made me wonder about drugs. Maybe there wasn't a murderer. Maybe Courtney was on some drug—illicit, or a medication gone haywire—that would not only explain her behavior but set off some kind of heat-generating reaction in her skin. I'd never heard of such a thing, but at least it didn't require murderers, monsters, or suicide.

But there wasn't much in her luggage out of the ordinary except rainbow earrings and a pendant that looked like a kitten or maybe a tiger cub. Kittens and rainbows: that, not drugs, was the Courtney I'd known.

I turned to her computer, looking for personal files or a journal, though even she was likely to have password protected anything important. Meanwhile, Marisa had moved closer to the door, shielding me from the draft.

Then, as I was discovering that Courtney had indeed kept a journal but that the password wasn't "penguin," "kitten," or "rainbow," the draft reintensified.

I glanced back to discover that Marisa had now opened a foot-long slit in the autoseal.

"What the hell?"

"It's too damn hot." She'd shed another layer and pulled down the zipper on her thermal shirt. "Can't you feel it?"

Suddenly, I had no interest in Courtney's diary. "Actually, it's rather chilly."

She was tugging at her shirt, fanning herself. "No way."

"I can see your breath."

She exhaled, generating a nice cloud of steam. Her eyes went wide. "What . . . ?"

"I don't know, but I think maybe you ought to put your jacket back on."

"But it's so hot."

"Not it. You." I reached out to touch her forehead with the back of my hand, like my mother used to when I was a child. "Maybe you've got a fever."

Fever was an understatement. She was burning up. She was also beginning to shiver. "Jacket," I said, desperately trying to remember everything I knew about fever and chills. It wasn't much. As long as you had a safe water supply—which we certainly did—infectious dis-

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ease wasn't much of a problem on mountaineering expeditions. What I did remember was that chills generated heat, which fed the fever in a runaway process that could kill you if your core temperature got too high.

There was a medkit in my tent.

"Are you with me?" I asked.

She nodded.

"Don't do *anything* until I get back."

This time, I was gone less than a minute, panting in the thin air. I'd tracked a lot of snow into my tent, but I could deal with it later.

Marisa was shivering worse than ever. But if anything, she was hotter to the touch. I nearly spilled the medkit in my haste to find a thermometer.

The first thing I found was one of those infrared skin-temp things. They usually give too-low readings in cold weather, but this one read an impossible 112°. Luckily, there was also an oral thermometer, but Marisa was shaking so violently I wasn't sure she could keep it in her mouth. Then, even as I watched, the shivering began to abate. Could you spike a fever and begin to recover that quickly?

While she incubated the thermometer, I rummaged through the medkit, trying to think of a fever med stronger than aspirin. An antibiotic might help, but the best emergency response to a fever, as I recalled, was an ice bath. Get the temperature down first, then find the cause.

Kind of like what Courtney had tried to do.

The thermometer was supposed to beep when it reached a stable reading, but Marisa was trying to talk around it and apparently it wasn't stabilizing. Her speech was slurred, but not yet incoherent. "Hot, hot," she mumbled, trying to fumble at her clothes. "Burning. Hot."

I gave up waiting for the beep. Could her temperature be changing so fast that it never had time to stabilize? I almost didn't want to look. In an adult, one hundred and five degrees is life-threatening. A hundred and eight is brain frying. It was hard to believe I wasn't going to see a truly devastating number.

Instead, it was ninety-one degrees.

I knew a lot more about that than I did about fevers. That's stage two hypothermia: slurred speech, lost coordination, bad judgment. Below that comes stage three, which starts with lassitude and ends with unconsciousness. Death comes somewhere about seventy-five degrees, give or take.

Maybe the thermometer was broken. I thought about popping it in my own mouth to give it a test, but hesitated. What if whatever Marisa had was contagious?

I touched her forehead again and found it hotter than ever.

Just like Courtney.

Whatever had killed Courtney worked like a disease, and Marisa had caught it. But why hadn't I? We'd both been in contact with the body. We'd both breathed the same air. We'd both . . .

I found myself gazing at the thermometer. The three of us had not put the same things in our mouths. Courtney had eaten soup. Marisa had tasted the soup and made hot chocolate. Somehow, they'd gotten a disease from the food. Some virus or bacteria. A very fast-acting virus or bacteria—

Then, I had it. Not a disease. Nanites. Somehow, presumably through the hot chocolate, the mobile bots had gotten into her and were trying to use her body to heat the tent. Just as they'd used Courtney's, first to heat the tent, then to try to heat the entire outdoors, until she ran out of heat and froze into a lump of ice, except for the nanite layer, which was still extracting as much heat as it could from the ice and pumping it outdoors, freezing the rest of her body ever more solidly in the process.

Ironically, that meant that Courtney, by stumbling outdoors, had actually been on the right track. Not that she'd been motivated by anything but a desire to cool her overheated skin. If she'd left

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properly dressed, and in time, all she would have had to do was to get out of range of the tent computer. Without instructions from the thermostat, the nanites would have shut down and maybe she'd have recovered. Or maybe not. The moment she'd gone into another tent, the process would have started anew.

Luckily, I had a simpler solution. "Climate controls off," I called to the tent computer, checking the display to make sure it complied. Then I wrestled Marisa into Courtney's sleeping bag and climbed in with her for the long, slow process of warming her back up.

The discussion with the home office was one of the strangest of my life. "We've got one dead and one who barely survived," I said. "I wouldn't blame her if she sued."

That, I knew, would get their attention even more than the tragedy itself. When the others got back, I'd had them take down all of the new tents and replace them with older models. "What the hell happened?"

Of course, none of the top brass knew, but eventually I wound up in a conference call with the techies—with a lawyer listening in, for good measure.

After a few preliminaries—of course, Courtney and Marisa had signed the waivers; they'd never have set foot in Antarctica otherwise—I finally got a chance to tell the design folks exactly what happened. They made me repeat everything five times, then three of them started talking at once.

"—huge heat gradient, completely inside the control perimeter—"

"—must'a drawn half the mobiles in the tent—"

"—supposed to recognize humans and keep away—"

"—but she ate them—"

"—even more efficient in solid state—"

"—damned code—"

"—ancestor was a reefer—"

"—I *knew* we should have written our own code rather than patching it—"

"—but those switchable heater/AC units were going to be so cool—"

Eventually I got them to slow down and speak English.

The bottom line was that the nanites were confused by the stove. They were too smart to immolate themselves on the burner, but the soup wasn't that hot, and they were somehow descended from bots purchased from a refrigerator-truck company. "It's just a matter of which direction you want the heat to go," one of the engineers explained.

Unfortunately, something about the stove activated some old programming and they swarmed to the heat, probably through the tent floor. Once Courtney and Marisa drank them, they did their best to find a surface akin to the tent wall or the walls of a refrigerator truck, winding up in the skin.

"So it's a design error," I said.

"Well—" the engineer began.

The lawyer cut him off. "That's not useful. This wouldn't have happened if she'd not used the stove in the tent, correct?"

"Yeah, you could say that," the engineer conceded.

"And you—" That had to be me. "You did tell them not to cook in the tent?"

I shrugged, then realized he couldn't see me. The only vid links had been in the new tents. "Sure, but not for that reason."

"That's okay. It was a safety rule. Both women violated it. It doesn't matter that the harm was different from expected."

"Those things definitely weren't intended to be taken internally," the engineer added.

"But why didn't they run out of power?" I was thinking about the drain the new tents had put on our solar nets.

"Oh, that's easy; they've got an array of excitable-state atoms that act like an onboard battery. If they don't have to move too much, they can go a long time if they start with a full charge."

"But you know . . ." one of the other

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engineers chimed in.

I could hear him take a deep breath. One person's tragedy is another's inspiration. To these folks, Courtney was just a name, and they were two continents removed from Antarctica. ". . . if we could tame the side effects, this could have a lot of uses. With the right enzyme conjugates, I bet we *could* design them to be taken internally. If they ate fat, we'd have the perfect weight burner. It would be like one of those fat-melting products you hear about on late-night vids, only this one would work. You'd have to control the rate of fat burn to keep from generating too much energy, and you'd need a way to say, 'Thin enough,' but—"

I switched off.

One of the advantages of voice-only transmission was that Marisa could be sitting next to me, listening in.

"Sue the bastards," I said. "Tell them you were scared to make hot chocolate in the vestibule because we thought there was a murderer on the loose. That's close enough to the truth."

My tent flapped in the wind. Somehow I found it reassuring. "Do it now, before they come up with another great idea." □

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The Purloined Labradoodle

Barry B. Longyear

Wherein Jaggers and Shad give new meaning to the phrase "impersonating an . . . officer?"

I had originally intended these narratives to address the more significant inquiries Guy Shad and I worked in our time together in the Exeter office of Artificial Beings Crimes. An incautious comment I made in my chronicle of Shad's death in "The Hangingstone Rat," however, touched upon my suspicion Shad might have his rescued engrams imprinted temporarily on a celebrity look-alike bio of British actor Nigel Bruce while his mallard duck replacement meat suit matured. Nigel Bruce, of course, was known primarily for his role as the bumbling Dr. Watson in the grayscale Sherlock Holmes vids of the mid twentieth century. I deduced this attire would amuse Shad to no end due to my police replacement bio strongly resembling Basil Rathbone, the actor who played Sherlock Holmes in the same series.

Since Shad regarded me as something of a foil for his humor, due to his former career as the American comic advert insurance duck on the telly, he could not possibly resist the opportunities for silly situations with us thus configured. This aside in one of my accounts, however, produced a rash of queries about the cases we worked thus resembling Holmes and Watson, *neé* Rathbone and Bruce. Not just the facts, mind you. These inquiring minds wanted to know down-to-the-last-flipping-detail, please and thank you very much.

Shortly after he moved into his new feathers, I discussed it with Shad. As always he had little interest in anything not involving movies, acting, his feline friend Nadine, or solving the current case. When I pointed out to him that the original Sherlock Holmes stories by Sir Aurhur Conan Doyle were narrated by Dr. Watson, hence rightfully Shad should author our adventures so made up, he looked up from his case file and said, "You know, Jaggs, despite my

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many quills, I've never been much of one for writing."

We were on three matters together with Shad in his Watson meat suit. The first of these inquiries I have titled "The Purloined Labradoodle." This inquiry initially had nothing to do with Watson or a Labradoodle. It initiated actually in relation to improperly imprinted puppies, an imprisoned parakeet, and a parrot profoundly perturbed.

"Limp stone," muttered the parrot darkly.

I finished stocking the shelves in back of the small shop counter with boxes of birdseed, tins of dog food, and little packets of catnip. The counter and display case were festooned with colorful leashes of assorted sizes; plastic bones; rubber mice; squeaky toys; scratching posts; king-, queen-, and knave-sized pet beds and such. The walls were hung with posters concerning the various hideous diseases cats and dogs could contract, complete with expensive preventative treatments that could be purchased right here, should the shipments ever arrive. Shad and I, you see, were undercover operating a pet shop in The Strand, Village of Lympstone, east bank of the River Exe south of Exeter, Devon. I was the pet shop owner and DS Shad had traded his cherished Nigel Bruce meat suit in on what budget-strapped ABCD had left over in the way of undercover pet bios: a rather timeworn parrot.

We were, as it happened, an insignificant part of a rather large task force attempting to crack down on a UK ring of swindlers who were representing real household pets as amdroid bios capable of taking full human imprints with rather appalling consequences for bargain seekers who would lose a good bit of their savings, all of their natural bodies, and most of their minds in the process. The main thrusts of the task force effort were in London, Manchester, and Bristol. Shad was being cranky on two accounts: first, because he felt we had been left out of the big show; and second, because he wasn't getting to do his Dr. Watson, which he really wanted to do.

Nevertheless, the pets used by the perpetrators came from somewhere and covering pet stores was a logical investigative consequence. From what we could observe from our post in Lympstone, though, it didn't appear to be a well coordinated operation—something Shad was beginning to refer to as a "clusterbugger." In any event, we were on our third day of operations and our shipments of kittens, puppies, and much of our equipment and supplies had yet to arrive. No bait, no customers, no suspects. I looked from the window at the quaint village street, and it was raining. There went our chance for someone blind drunk mistaking us for a tube station and wandering in.

"Limp stone," Shad muttered again from his perch at the end of the counter. He was getting quite tiresome. I turned from the window.

"Actually, Shad, the *m* is silent and the *stone* is pronounced *stin*. Lipstin."

"Brits pronounce a whole lot better than they spell."

"I don't recall that American insurance company you did the telly adverts for being such great spellers. Why wasn't your duck quacking 'Aflass, Aflass?'"

"You mean besides how close it sounds to 'half-assed'? Jaggs, you really think 'The Petting Place' is a good name for a pet store?"

"Superintendent Matheson chose the name, not I, as you well know."

"It sounds like a bordello or lap-dancing salon. Why don't we just call it 'The Cat House' and be done with it?" The parrot held out his wings, began bumping and grinding his hips as he danced on the perch, and sang out in something of a Jamaican accent, 'Hey dere, sailor boy, you come to Mama Bimbo's Cat House for all you pettin' needs,

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mon." The dance stopped. "Jaggs, if you were a self-respecting crook would you go into a pet store called The Petting Place?" He sidestepped grumpily from one end of his perch to the other. "Can't believe the names around this neck of the woods: Ex mouth. Nut well. Glebe lands. Cock wood. Under Wear—"

"That's *Lower* Wear and—"

"Key off, Jaggs," cautioned Shad, nodding toward the window. "Live one approaching. This may be the kitten pickin' kingpin herself."

The bell rang as the door opened revealing a short, stocky woman in a green anorak and yellow plastic rain scarf, her feet in a pair of bright yellow wellies. In her right hand she had by the handle a small gray metal case. She walked up to the counter.

"Good morning, love," I said. "How may I be of assistance?"

"I want me parakeet fixed," she stated.

"Indeed. I regret to say we don't neuter birds at Petting Place." I glanced at Shad and he was returning my look down his beak, as it were. I looked back at the woman. "You'll have to take your bird to a veterinary surgeon."

"I means *repair.* This one's a robbie," she said. "All 'is nuts's got bolts in 'em, if you gets me drift."

"I see." I smiled brightly. "If I might take a look at your bird?"

"Nothin' much works on it." She lifted the case and dropped it rather heavily on the counter. "Salt in the air, I expect. Too close to the bleedin' ocean."

I opened the case on the counter next to Shad's perch. Inside the case was a musty-smelling robotic parakeet. There was something white and crusty dried between its toes. Shad moved on his perch until he could look down into the case.

"Ain't that cute, your parrot there looking at me bird. He's in love!"

Midway through her rising belly laugh, Shad said to her, "Sod off, you old cow."

"Here, now!" she responded, her color rising.

"I apologize for the parrot, love," I said. "I'm afraid we rescued the poor thing from a rather tragic situation."

"Aw," she responded empathetically, reaching out a hand to pet Shad's head. "Chick abuse, was it?"

With a loud squawk and a belated flap of his unfamiliar wings, Shad fell off his perch backward onto the floor.

"I didn't hit the poor thing," said the woman holding a hand up to her maker. "I swear it."

"Please don't distress yourself unduly, madam. The bird also suffers from an inner ear problem. It affects his balance." Excusing myself, I went around the end of the counter and bent over my partner. He was rolling on the floor flapping his multicolored plumage, beak open, and laughing. *"Steady,"* I said to him over our wireless net, a deserved degree of menace in my transmission.

After a few gasps, Shad eventually said to me, *"Sorry, Jaggs. Ah-hah! Sorry, but check out the eyes on her bird. That's no simple robot."* He stood, doubled over, shook again, and transmitted, *"Should I share with her how I was never coddled as a young egg but spent my deviled youth getting fried and have since become hard-boiled?"*

"Not unless you also wish to become scrambled and beaten," I buzzed back.

He flapped his wings and resumed his place on the perch, occasional unconquerable snicker spasms shaking his feathers.

I turned toward the woman and smiled brightly yet again. "Now, shall I take a look at your bird?"

Shad was correct. The creature's eyes were animated, its gaze darting about and eventually coming to rest upon me. If it was a simple rundown robot and not a mech, its eyes should not have been moving. As they were moving, however, indicating the possibility of a rather serious crime, I asked as delicately as I could, "How long have you had

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this mech, love?"

She laughed and waved a hand at my apparent silliness. "Oh, that's no mech, dearie. That one's just a clockwork toy. Me aunt were well off, but Auntie wouldn't pay for no mech when she could get the feathers, flap, and song by only payin' for a robbie."

"Really."

"'Course. Think she wanted to get tied up with all that red tape, wages, taxes, forms, and bother? Not me Aunt Annabelle." She frowned. "Besides, if this here bird was self-aware, it'd take better care of itself, wouldn't it?" Before I could answer, she added, "More to point, that's what the parakeet told me aunt."

"This parakeet told your aunt it didn't come under the Artificial Intelligence Regulations?"

"That's what me aunt told me years before she passed on. The parakeet told her, oh—" She frowned and looked up at the beamed ceiling. "—got to be four years ago." She lowered her watery gray gaze down until she was looking me in the face. "See, Annabelle Wallingford passed last year. Quite well off she was, as I said. Her place was in Wotton Lane by Watton Brook."

"In Wotton by Watton?" asked Shad.

She frowned at the parrot. "Cheeky bastard."

"To be sure. About the parakeet?" I prompted.

"Well, as part of Auntie's estate, she left me Ringo. That's what we called this here bird before it seized up. Shame. Only had the bloomin' thing a few days when it broke."

"I see. And you're bringing it in now because. . . ?"

"Just getting around to going through me aunt's things and cleanin' up. Found Ringo tucked away in me auntie's attic. Maddie girl, I says to meself, it'd be right homey havin' a singin' bird in the lounge next to the settee. Ringo sings real sweet's, I remember."

"I see."

"With a robbie there's no papers to clean up. No offense," she said to Shad.

He looked away, talon to brow, feigning acute personal devastation.

She poked the parakeet several times in the tummy. "I can do the feathers up some with needles and me hot glue gun, but I'm no good with chips, springs, electronics, and such. If it can't be fixed I'll just toss it in the dustbin. Maybe a jumble sale. Some little tyke might have a laugh takin' it apart. Might be worth a bob or two."

I lifted a wing and released it. It dropped to the counter with a thud. "Let me take it in back and have a look."

"Is this old parrot here for sale?" she asked, poking Shad in the belly.

"Easy, lady," he said with the voice of Huntz Hall, "you'll bruise the fabric."

"You'll have to ask the bird, love," I answered. "He's a bio."

"Oh, I wouldn't want no bio."

"That's not the issue, Chuckles," Shad said to her. "The issue is, does the bio want you."

As I picked up the parakeet and carried it around the counter, Shad began singing a rather raunchy sea shanty centered on a seductive female giraffe and her erstwhile suitor, a love struck field mouse who, for reasons unnecessary to elucidate here, ran himself to death. I took the mechanical bird into the room where we had our surveillance equipment set up. I cracked the parakeet's back and Shad was right. Although the bird was robotic, there was one slight illegal modification. Tucked among its gears, bellows, batteries, and computer was an AI chip—an illegal AI chip at that. I'm no expert in such things, but it looked as though the AI chip had worked its way loose from its improvised mountings, which had caused a microcard to partially dislodge from its tiny motherboard effectively paralyzing all motor functions save the eyes.

With a pair of tweezers I disconnected the AI chip, took it over to the workroom's computer, and inserted it into

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the appropriate port. All of the identification data on the chip was code scrambled. I keyed for voice recognition and said, "Hello. Hello, hello, whoever you are."

No response.

"Detective Inspector Harrington Jaggers, Devon ABCD here. I know you've just gone though a rough patch, old chicken, but it's about to get a good deal bumpier. Either you talk to me or I put this chip right back in the squab the same way I found it. Then one of two things happen: either Maddie girl will toss you in the dustbin, or perhaps she'll put you in a jumble sale and someone six years old with sticky fingers will take you all apart before he loses interest and goes on to something else. Or perhaps they'll make a Christmas tree decoration out of you. Pretty little bird. The way I read your battery consumption rate, you have another two—two and a half years you can click around those eyeballs up on some shelf until things go dark for good. But who can say? Sitting on the tree next to the candy cane once a year, looking through the plastic icicles, listening to tattooed and perforated children playing their new thunder rumbles. It might be fun listening to Dad and Uncle Mike wagging on endlessly about test matches, especially after they've gotten good and bladdered, before you go back in the box—"

"Very well," interrupted the computer's speakers in a female voice. "You got me."

"Indeed." I thought I'd give my American partner a little Don Ameche wireless moment. *"Mr. Watson, come here, I want you,"* I transmitted to Shad.

The parrot flew through the door and landed atop the computer monitor. *"The Story of Alexander Graham Bell,* Nineteen thirty-nine, and that wasn't the Watson I was hoping for."

"That's all right, Shad. Right now you don't look much like Henry Fonda, anyway." I pointed at the screen and Shad looked down between his feet. A female human CGI was on the screen.

"That's not Loretta Young."

I looked at the lovely creature. "I do believe that's Rita Hayworth." The computer generated image, indeed, looked like 1940s and '50s actress Rita Hayworth in her role as the sultry nightclub singer in *Affair in Trinidad,* with Glenn Ford. I frowned at Shad.

"Nineteen fifty-two," he said without looking up.

Insufferable bird. I looked back at the screen. Pirate AI chip manufacturers paid no royalties for images, but steered clear of using images of still living celebrities who could afford to hire the forces of darkness necessary to hunt down and prosecute trademark poachers and encroachers. Rita, as always, was looking radiant. "Your name?" I asked her.

"Lolita Doll." Rita smiled demurely. "Honest, guv. That's the name I was born with, spelling and all. I'm from Plymouth by way of Land's End. Thanks for busting me out of that parakeet."

"You're not out of the feathers yet, love," I said evenly. "I'm kind of curious how you wound up in that chip, how that chip wound up inside that bird, and especially how that bird wound up inside a wealthy woman's estate."

The image was silent. From his perch atop the screen, Shad said, "Is it just me or is Rita looking just a bit furtive?"

"What's that parrot saying?" Rita—Lolita—asked me.

"Detective Sergeant Shad opined that you appeared just a tad sneaky, Lolita. I agree you seem less than forthcoming."

Shad hopped down to the keyboard, did a little dance on the keys, and called up Lolita's previous in a new frame. "Whoa!" he exclaimed in mock shock. "Lolita," said Shad, "I'd download your complete criminal record, but this sorry shadow of a computer only has fifteen hundred megagigs of memory."

I glanced at the list. Sealed juvenile previous weighing a third the megabyte weight of her adult convictions. She was

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a jewel thief primarily, some confidence work, not terribly competent at either. She couldn't have done much worse if she'd spent her mornings booking cells for her evenings through the Convict Accommodation Association. Did her first stint in H.M Prison and Remand Centre Exeter at the age of nineteen. Back in at twenty-two. Back again at twenty-five. According to the record I was reading she was nearing sixty and more than half of that time had been spent as a guest of His Majesty's government. According to her library record in the nick, she'd read every piece of children's fiction in the place. Psych evaluation: Terrific liar; couldn't change a battery; at risk for becoming institutionalized, which meant she's been inside so long she'd do almost anything to stay behind walls.

"So you modified a robotic parakeet with a pirated mech AI chip capable of taking a human imprint to sneak past the security systems into some wealthy person's home," I said.

"Yes."

"You do the work yourself, Lolita?"

"Sure."

Shad whistled a bar from the Woody Woodpecker song. True. If she had been Pinocchio instead of Rita Hayworth she would have had a California redwood hanging from between her eyes by now.

"How could you be sure that parakeet would be chosen by your mark?" asked Shad.

"The robbie was already sold to Annabelle Wallingford," answered Lolita. "I did work release at Songbirds in Queen Street, Exeter. It's a tech shop sells robbie birds and accessories. You know, it's just up from Boston Tea Party, in next to the News?"

"Yes," I said. "I know it. It's owned by Frankie Statten, isn't it?"

"Mr. Statten's the proprietor."

Shad glanced at me and I shrugged. "You were on work release?" I continued.

"So?"

"Doesn't say a whole lot for the rehab program up there," observed Shad. "The parakeet robbie gimmick, Lolita: What made you think of it?" he asked her.

No answer for a while, then Rita said, "I suppose it seemed like a good idea at the time."

The parrot looked up at me. "Well, Sherlock, I guess she's got nothin' to hide."

I sat down on a stool and looked again at Lolita's file. The picture of Lolita Doll—taken when her nat was about thirty—although of typical constabulary quality, was not unpleasant. Her photo gave the impression of a lonely, frightened girl trying to look tough and into her third decade of refusing to stand up straight. Her most recent photo showed her sadder, grayer, and a bit more stooped. "Swap your body for the AI chip and imprinting, did you?" I asked, not much interested in the answer, knowing it was going to be a lie.

Rita Hayworth glanced at the window, then looked away. She nodded. "Just another meat suit, wasn't it. Didn't like the way I looked anyway. With what I would've made off the Wallingford job—I could've become . . . I could've become . . . why, just anybody, couldn't I." Rita shrugged and looked down.

"Who would you have liked to become, Lolita?" I asked her.

"What're you, copper? Bleedin' Mother Mary?" The sneer Rita had on her face was not attractive at all and was quite contradicted by the tears welling in her CGI's eyes.

"Listen up, you sorry scrap of plastic and magnetic impulses," snarled Shad into the workstation's camera pickup, "You are talking to Detective Inspector Harrington Jaggers of Interpol's Artificial Beings Crimes Division's Devon Office, late of the London Metropolitan Police, the cop who's put away enough blood-and-guts stone killers to fill the recruiting needs of every tattooed and drugged up prison gang in the United Kingdom, Wales, and the Maldives until the next

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millennium! So unless you want your highly illegal AI chip to accidentally find itself flushed down the Petting Place's toilet, me girl, you'd best straighten up and answer up, 'less you want to find yourself up that bleedin' pile of sand and rock, haulin' a rucksack full of ruddy flippin' shot puts!"

He had begun as Jack Webb in *The D.I.*, but at the end had slipped rather badly into Harry Andrews in *The Hill*.

"Steady there, Shad," I transmitted.

"Sorry," he sent back.

Rita was looking rather wide-eyed at the parrot. After a moment her gaze shifted to me. "Sorry, Inspector. Didn't mean anything."

I cleared my throat. "Who would you have liked to become?" I asked her again.

Rita was trying, struggling for words, her eyes welling with electronic tears. "I don't know. I want to be . . ." She looked directly at me. "I want to be safe." She nodded to herself. "I'll tell you, inspector. Safe. Taken care of." She glanced away for a moment, as though embarrassed. "Had that inside, kind of. You know?" She looked back at me. "Wasn't happy, though. I do so want to be happy."

"What about love, Lolita?"

"You having a laugh, guv?"

"No."

"Don't mix me up with the picture on the screen, Inspector. I'm near sixty. Love's something you read about in the romance graphs. Money, now." She smiled wickedly. "They tells me money can't buy me love, but it do make the search a heap more comfortable."

"Spare us the brass, sister. What happened this time?" asked Shad.

She glanced at the parrot and shrugged. "Me own fault. Flying around the place, scoping out the security systems, I ran flat into something. Never saw it. Jammed me up. Froze me solid. Everything but me eyes and ears. Butler found me next morning, put me on a shelf. Auntie shakes her head. Auntie's brother, Barney Bananas, takes me up to his room and sticks me on top a nine year old slice o' wedding cake he was saving for his future missus, which give me sticky feet and a good look at his telly. 'Course he only played this one vid he liked, over and over and over, day in and bleedin' night out for a year three months a week and four days until Barney Wallingford died right in the middle of Lawrence Harvey gettin' kissed by his mum for the last time as it turned out. Then they packed up Barmey Barney's belongings, including me, and stuck us all in the attic for another three years. The last I saw the light 'til Maddie checked me out to bring me here."

"Is she lying?" I transmitted to Shad.

"What was the name—" he began out loud.

"*The Manchurian Candidate,*" she answered, "Frank Sinatra, Lawrence Harvey, Janet Leigh, Angela Lansbury—"

"The dir—"

"John Frankenheimer."

"Pro—"

"George Axelrod and John Frankenheimer, Executive Producer Howard W. Koch."

"She may have seen it," Shad reported back.

"Don't you want to know who did Janet Leigh's hair styles?" Rita Hayworth asked the parrot. She pulled back the left corner of her mouth into a knowing smile. "Or do you already know?"

The parrot looked up at me. "Only a fool bandies wits with an electron," I offered.

Shad looked back at the screen. "Who?" he asked.

"I rest my case."

"Gene Shacove," she answered.

While Shad went on the net to check out her answer, he asked Lolita, "Why didn't your partner come and get you out?"

Rita arched her lovely brows. "Partners look out for each other. If I had a partner you think I would've gotten into such a fix?" She looked down. "Four

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years," she said. "Four years."

"What did you do all that time to keep from going crazy?" asked Shad.

Rita stared wide eyed at Shad. "Why, birdie, I passed the time by playing a little solitaire."

We both fell silent as Shad and I reflected upon the famous trigger-the-killer line from the original *The Manchurian Candidate*. He pointed his wing at the frame next to Rita. Janet Leigh's hairstyles by Gene Shacove.

Shad looked at Rita. "Ever see the remake to *The Manchurian Candidate?*"

Rita nodded, smiling wickedly.

"What'd you think?"

"I'd rather go back and watch the original another fifty-five hundred times." Her CGI looked at me. "What are you going to do with me, Inspector?"

"To be perfectly honest, Lolita, I don't know. Hence, I'm going to pass the buck. I have a friend in London and this parrot, Dr. Watson here, is going to send your engrams and particulars to my friend for a second opinion." Shad looked at me all wide eyed and quizzical. "Dr. Bing Ehrenberg. You'll find his address in my personal folder. Attach a copy of Lolita's previous along with a brief description of the current situation, what she's been through, and our assessment of her account, and send the lot to Dr. Ehrenberg. Include her complete prison record, as well." I looked one last time at Rita. "While he's doing that, I'll see if I can repair old Ringo and get the bird singing again. Once I hear from the doctor, I'll make my decision." I put her on pause.

Later, as Lolita's engrams and history were bouncing off a satellite, I told Shad to destroy the AI chip once Ehrenberg confirmed receipt and installation. Then I turned my attention to Ringo. I brushed off the crumbly old icing from its toes, reattached the parakeet's robotic computer, anchored the minicards, reattached the remainder of the connections, buttoned it up, and listened as the bird began singing the sweetest bird songs. I held out a finger and with a flap of its wings it jumped up and perched there, shook the dust from its back and wings, the remaining bits of wedding cake from its toes, its happy song filling the air. Picking up the carrying case by the handle, I brought the patient back to our client. Maddie girl's face blossomed into smiles. "Bloody Nora, Ringo's as right as rain. I comes in here and says to meself this here Sherlock Holmes and his bleedin' parrot're a couple of barmpots, but who's arse-up now? Eh? Ringo's right as rain."

"Like sands through the hour glass," began Shad, "so are the days of our lives—"

"Shad," I interrupted with a mix of menace and smile.

Since our credit numbers and equipment were out there somewhere awaiting delivery along with our puppies and kittens, we took Madeleine Wallingford's address ostensibly for billing purposes and agreed to put an advert in the window for an outing to the medieval underground tunnels of Exeter being organized by the Lympstone Society and another for Maddie's own group, the Order of St. Trinians, ta ta, Abyssinia, and all that twaddle. The door closed.

Quoth the parrot, "Nevermore."

"Sorry?"

"Jaggs, I think I see the purpose of this catch-and-release policy of yours. We're trying to build up the criminal stock out there in the mainstream so that there will be criminals enough for all law enforcement officers everywhere to make a living. It's part of the Blue Peace Environmental Movement, right?"

"Although I truly admire the depth of your cynicism, Shad, certainly someone of your sensitivity and high intellect can appreciate that Lolita Doll has learned everything confinement at government expense can teach her."

"I heartily agree with your modest assessment of my mental prowess, Jaggs, but you must really be sticking something tender beneath a pinch bar if you

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have to resort to such blatant flattery. Who is this Dr. Ehrenberg, anyway?"

"Chap in London. Therapist. Back when I was killed in Metro, he went a long way toward piecing me back together and into my first bio. If Bing says tossing what's left of Lolita Doll before a magistrate is what's best for her, then off she goes. If he says we do something else, then we'll see. Meanwhile, give Superintendent Matheson a ring and see if anything is brewing."

He did and something was. While Shad and I had been in Lympstone disposing of Lolita and the kaput parakeet matter, ABCD units in Manchester and London, in conjunction with local police authorities, had successfully detained all the improper puppy imprinting principals as well as their primary patrons. The bogus bio barons had been bagged. While muttering, Shad flew to the shop's garage and copied back into his Nigel Bruce, I bent to the task of repacking all those bloomin' boxes of bird seed, tins of dog food, and little packets of catnip. Mama Bimbo's Cat House was going out of business, mon.

As Shad drove us back to Exeter he said in his Watson voice, "Of course, Holmes, Frankie Statten was her partner."

"Of course."

"Why didn't the fellow rescue her?"

"Never let it be said that Frank Statten unnecessarily placed himself at risk for anything or anybody."

"Honor among thieves. Humph! Stranding her like that," said Watson in disgust. "What do you suppose it was like, Holmes, after watching that vid a few thousand times with Barmy Barney then shut up in a little box in the dark for another three years? Nothing to move but your eyeballs? Nothing to think about but *The Manchurian Candidate.*" He shuddered convincingly. "Had to make two weeks of solitary confinement seem a mere stroll in the park."

"It must have been strikingly like an experience I had years ago in London shortly after I died, Watson." I wondered slightly at my use of the "Watson" name. Came devilishly easy to the tongue for someone who swore the name would never pass his lips.

"In a cast were you, Holmes?" asked Watson. "Held in stasis a long time, old trout? Medically induced coma?"

"Not at all, old fellow. Valerie took me to see a showing of the Bette Davis-Lillian Gish classic, *The Whales of August.*" For once Shad didn't immediately come back with the release date. He simply shuddered.

"Dear me," he said. "You gave me quite a start, Holmes. Had a shockingly similar experience with Nadine not long ago," he said.

"Really."

"I should say so. They had the bloody thing at the Exeter Picture House. Special treat. I'd never seen it before. *The Whales of August.* Ought to require theaters to post well-being warnings before showing the blithering health hazard."

"Were you convinced you were running a risk, doctor?"

"Holmes, it was like watching quartz crystals grow in real time."

I shook my head. "I didn't find the action quite that compelling."

Nigel chuckled a Watson chuckle. "You know, Nadine quite likes that movie, Holmes. What do you make of that?"

"Nadine's a cat. *The Whales of August* does bear a striking similarity to watching a mouse hole for three hours. Val is rather fond of *The Whales of August*, too, you know."

"Really. Well, perhaps it is a feline thing."

I thought for a moment. "Not exactly. You see, Val wasn't a cat when we saw it."

"But she became a cat, Holmes. Everything was there but the fur and whiskers, you see?"

"Perhaps. Yes, I'll grant you that, Wat-

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son. Well done." I glanced over at Shad and he was doing a very good self-satisfied Watson chuckle having gotten-one-up on Sherlock Holmes. Detective Superintendent Matheson's face came into my thoughts for some reason. "Two things before we get back to division, old fellow."

"What's that, Holmes?"

"One, when we get in the building, you must stop calling me Holmes. Two, I see that deerstalker cap you have in your pocket."

"Oh?"

"I don't want to see it on my hat rack."

"What? Wha—What makes you think I wasn't going to wear it myself, Ho—Jaggs?" he asked, feigning injured innocence.

There was only one phrase that seemed to fit. "Elementary, my dear Shad. Elementary."

Time passed as it has a wont to do, and Bing Ehrenberg eventually rang me to say that he believed the best thing for Lolita Doll was to get her out of a computer and into a human bio, into some therapy, and into some vocational rehabilitation. I discussed the matter for all of eleven seconds with a county crown prosecutor's assistant who had less than no interest in the case, and the fellow proceeded to discharge it, including the eleven months she had remaining on her previous sentence. Lolita had done four years in solitary for attempted burglary and was now free. I suppose Justice does have to lift that hanky once in awhile and have herself a peek.

Shad and I, on the other hand, went out on a deranged squirrel call in front of Debenhams and there witnessed a three vehicle pile-up as two ground electrics slammed into a lorry, whose driver stopped in the middle of his lane of traffic because he was stunned at seeing the real Sherlock Holmes and Dr. Watson. Chief Constable Raymond Crowe, who had yet to be found out for crimes of his own, buzzed D. Supt. Matheson about getting Shad back into his feathers. At the very least, Matheson was to keep us off the streets. The squirrel withdrew the complaint against Debenhams, but insisted upon autographs from Shad and myself. He returned our early efforts pointedly remarking that no one had ever heard of Harrington Jaggers and Guy Shad. After we sent the furry fellow off with the Holmes and Watson inscriptions upon which he insisted, Watson looked at me and said, "Why are you looking so glum? So it wasn't for your own name. Cheer up. It *was* your first autograph request."

"That is true."

"Consider my plight, Holmes. As the Aflak duck I was asked for countless autographs but couldn't sign them. Now I can sign them but they don't want my name."

"Well, cheer up, Watson," I said. "At least the squirrel didn't demand you quack out 'aflak' and fall off a cliff. Every cloud has a silver lining."

"You ever try flying *through* a cloud that had a silver lining?"

Early one sunny afternoon, a call came into ABCD from Powderham Castle, the home of the Earl of Devon. The castle was located almost directly across the River Exe from Lympstone, between the Village of Powderham and the larger village of Kenton. The call had been placed by the head of security at the castle, a former assistant chief constable of the West Midlands Constabulary named Ian Collier whom I had known many years ago from a case I had worked when I had been with Metro. A quite capable fellow, Collier. I had lost touch with him by the unfortunate expedient of getting killed. I fully expected him to be chief constable by now. Silly me. Instead he was Mr. Collier and running a private security force at a castle that doubled as a mini theme park and convention center with all kinds of events from nature walks and children's theater

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to weddings and rock concerts. Collier had called me directly.

Earlier in the day a large wedding had been held at Powderham in the castle's ornate music room. The reception luncheon, curiously enough, was held in the selfsame music room, while the music, with its concomitant dancing was taking place in the castle's huge dining room. Conversing, apologizing, promising, drinking, changing, pilfering jewelry, and recovering from various excesses were spread among the other rooms that had been made available to the wedding party.

The father of the groom, a Mr. Edsel Meyer, first reported one of the guests missing her jewelry, a rather expensive triple strand of matched natural pearls. Later, other guests reported missing jewelry until even the bride, the former June Grimpion and grandniece of Lord Devon, reported missing an emerald-cut diamond bracelet. The total promised to be a respectable haul. Ian Collier stated quite bluntly that he wanted that which could be done in an unofficial capacity to be carried out in exactly that manner.

When I reported to the superintendent, Matheson, who was a John Dillinger look-alike bio, wondered why Collier had called Artificial Beings Crimes.

"Possibly he suspected AB involvement," I offered as a plausible but completely untrue explanation.

"Perhaps you should knock this over to the constabulary, Jaggers," Matheson said as he contemplated his graphic of the Biograph Theater in Chicago, on the liquid crystal wall opposite his desk. He shifted his gaze toward me. "At least until we know for certain an artificial being is involved. Things are so touchy with Middlemoor lately I'm afraid the chief constable only needs one more little excuse to go off on the lot of us. Met Parker in the lobby downstairs yesterday and I swore the chief was going to rip a patch out of Parker the size of a throw rug. This office can't afford to put that gorilla back into therapy."

I glanced at Dr. Watson as he stood there fumbling with his deerstalker, and said, "Actually, sir, we were specifically requested by Powderham Castle. Hence, I'm certain there must be an AB involvement."

"Lord Devon specifically asked for us?" I could see the stars glittering in the superintendent's eyes.

"I took the call myself," which was not a lie. "In addition, sir, it would be an opportunity to get Dr. Watson and myself away from the tower for the afternoon, what with the inspection of the Exeter Station by the chief constable rumored to be occurring at almost any moment—"

"Omigod!" He placed both hands flat on his desktop. "Ah, I see. I see. Godspeed, Inspector Jaggers, and convey my respects to his lordship."

"I will, sir. Come Watson."

"What? Oh? Game's afoot, eh?"

"Don't you two play at that Holmes and Watson nonsense out at Powderham, Jaggers? Shad? You hear me? Shad? *Shad?"* Matheson cautioned as his door closed behind us.

As the doors to the elevator hardened and the car ascended, Watson said, "What was that fellow blathering on about, Holmes—all that playing at Powderham rubbish?"

"I haven't the slightest, Watson."

Up on the roof, we settled into the cruiser. As Watson drew us out of our slot and headed the vehicle toward the target, I rang up Collier and let him know we were on our way. *"The security is excellent at Powderham, Jaggs, but not oppressive,"* he said. *"Permanent security staff is long term, all retired police officers. We mostly stay outside the castle on the grounds. No guards inside. For big weddings like this one we make up extra security staff with local off-duty police, all good cops. Couldn't fault one of them."*

"Cameras?" I asked.

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"A few remote recording cameras on the grounds—nothing manned. Again, nothing inside the castle. Lord and Lady Devon let parts of the estate for weddings, corporate functions, and other events—in that respect Powderham is very much a business. However, the castle is also their home. The more valuable artworks and sculptures have motion detectors, sensitivity sensors, alarms and such. Anything that isn't bolted down has ID nanodots concealed on or in it—no way to get them out of the castle."

"What about nanodot codes on the guests' jewelry?"

"About three quarters of the missing pieces have them. Nothing's come up at the gates, and no one's left by air. No guests have left yet and no castle staff."

"Who has left?"

"The first shifts of caterers, florists, technical and lighting crew, photographers, a quick raid by a discreet liveried dustbin brigade, and the Lord Bishop of Exeter. We checked in, beneath, above, through, and around everything that could block a signal."

"Years ago, Collier, I had a case in which a well-endowed woman concealed a nanodot encoded diamond ring between her breasts and got it through the screens. There was a sufficient enclosure of flesh to absorb the dot's signal."

"There is sufficient jewelry already reported missing to pack an overnight bag, Jaggers. In my entire life I've never seen anyone that well endowed outside a perv graphic."

"Ah, sweet bird of youth."

"Indeed. I am aware other cavities have been used in which to conceal valuables, but have you ever seen the points and edges on emerald cut diamonds?"

"Yes I have. I agree: It would take quite a fellow to stick a bracelet full of them up his bum and still play bass guitar for two hours."

"Jaggers, unless the thief burrowed out underground, the stuff's still on the grounds."

"I take it you've checked possible underground routes and locations?"

"What do you think? I should make clear, Jaggers, that the castle is not liable for any stolen property. That's not his lordship's concern. It's just that his lordship is related to the bride's family and is a guest at both wedding and reception, as well."

"Hence he would prefer not having the screws slamming his fellow guests up against his ornate walls, spreading them out, and patting them down."

"You are so sensitive, my friend. I knew calling you was the right thing to do."

"See you in a few, Collier."

Watson pulled the cruiser up from Heavitree Tower as Collier sent me lists of wedding guests, wedding service and catering staffs, as well as castle staff including full-time and part-time security personnel, along with images.

As we took the Exminster-Dawlish Warren Air Corridor down the west bank of the Exe, Dr. Watson *neé* Shad turned on the autopilot, leaned back from the controls, and glanced at me. "Powderham. This is the place with the old tortoise who entertains children, Holmes. Timothy something?"

"You are correct, Watson. The first Timmy Tortoise dates back to 1854 and died in the early twenty-first century. The current one is an amdroid bio taken from the original Timmy's DNA imprinted by—her name escapes me—an actress."

"Went down there with Nadine, Holmes, and caught the woman's act just before we were blown up that time out at Hangingstone. Quite depressing."

"Getting blown up, or the tortoise?"

"Tortoise—What? Oh." He chuckled. "You will have your joke. Her *act* was depressing, Holmes, her act. Rather get blown up again than have to sit through her routine again. Dreadful. Hundred-and-fifty-year gig and all the flies she can eat."

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"I suspect the actor imprinted onto the Timmy bio restricts her tortoise fare to lettuce, Watson. Perhaps the odd tomato slice. I hear she does impressions. Is that true?"

"Dear God, Holmes: Turtle standup comedy impressions for seven year olds. No one should miss it. 'Hey, man, I heard these two bugs talking the other day, y' know? One says to the other, "Katydid." Now, get this. The other says, "Katydid." Stop me if you've heard this one before. So the other says, "Katydid." Now, the second bug comes back real quick with "Katydid, ha, ha, haaa . . ."'" Shad looked through his side of the window and back at me. "Dreadful. Well, it's work I suppose. Clarice Penne's her name." He glanced back at me. "Ever see her picture?"

"I can't say I have, Watson."

"Hideous looking woman. If she'd let herself go a little she'd be a dead ringer for Alistair Sim. There'll be a part for her if they ever decide to tell the story of Jack the Ripper's waning years in a nursing home."

"Alistair Sim of the Ebenezer Scrooge Sims?"

"The very same. Not a whole lot of really creepy maiden aunt parts available these days. I suppose she figures the shell game is at least show business. Reminds me of that old joke about the fellow in the circus scrubbing the elephant's bum." He coughed a Watson cough. "Sorry, Holmes. This wretched acting business: Millions grasping hungrily for a scant dozen brass rings. Had one of those rings once myself." Silence as he thought for a moment on his famous past, then he shook his head and waved a hand as if dismissing it from his attention. "Sorry. Sorry, Holmes. Can't imagine what came over me. Got a head full of fuzz lately. Apologies."

"Think nothing of it, old fellow." I frowned at him. How much was fuzz and how much was Shad doing his Nigel Bruce's Watson?

He sat in silence for a long time apparently thinking heavily upon something of great importance to him. At last he asked, "Why else does this Powderham Castle sound familiar to me, Holmes? It's stuck in my head like Tom Mix and Hannibal Lecter, but I can't seem to place it."

"Why, I'm astounded, old fellow. Did your Nigel Bruce Watson getup come with a bumbled brain program?"

"Bumble—No need to be offensive, Holmes. I asked but a simple question."

"Now, no need for hurt feelings. Late in the twentieth century what famous motion picture was partly filmed at Powderham? Remember?"

"A vid?"

"Think, now." I raised an eyebrow in his direction. "Come, come Watson. Anthony Hopkins . . ."

"Motion picture? Hopkins? Wait, wait . . ."

"Ed—"

"No! Edward Fox! Hop—*Remains of the Day.* Of course. Emma Thompson, Christopher Reeve, Hugh Grant—Powderham is Darlington?" He looked at me, bushy gray eyebrows arched. "Dear god, I am bumbled! What year?"

"Nineteen ninety-three," I added with a touch of smugness as I looked over the lists and images supplied by Ian Collier, which also included images of the pets brought by a few of the guests. In a flash I knew who stole the jewelry as well as how it was done. What to do about it, however, was going to take a bit of detail sorting.

"Having trouble finding the culprit, Holmes?"

I nodded toward his screen. "Have a go at it, Watson. While you're busy at that, I need to check some details."

On my screen I checked my details. My suspicion turned out to be correct. Assistant Chief Constable Ian Collier had been allowed to take immediate retirement from the force sixteen months ago for unspecified reasons. Using some computer tricks Shad taught me early in our relationship, I managed to find out those unspecified reasons involved spe-

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cific unauthorized use of police equipment. It was all in the notes. I triggered the special links, entered a private code or two, and found the answers I needed. How mundane the scandalous tale once unfolded.

When the Collier family dog, a golden retriever named Laddie, was dying, ACC Collier had had a patrol cruiser with him at his home. In the grip of despair, he and his two young sons put Laddie into the cruiser to rush him to the vet. Laddie, however, died along the way. Ian probably hadn't even thought about it. The equipment was there, so were his sons, and so was the need. He harvested Laddie's engrams onto a chip—police cruiser, police reader, police chip. What to do with the harvested engrams after that got lost in the dust when the cruiser's automatic after-action report was picked up by a hostile media. It was then reviewed by a cautious deputy chief constable, judged by a frightened board, defended by an indifferent Association of Chief Police Officers, and resulted in forced retirement. Birmingham and West Midlands found itself with one less good cop. Then it was job-hunting time, new digs, new schools, new church, new friends, same family minus a dog, a home, and maybe part of a dad.

For every detail sorted, a new one needing a sort popped up. I rang a number. Bing Ehrenberg was in and available. I sent him what I had along with my best guesses regarding who and what to do. He agreed with me, which settled a couple of details. He asked a few questions. I answered them. Bing was happy to hear I was enjoying my work again. I told him I had been blown up and was working for John Dillinger. He asked about Val. I told him she was now a cat. Asked about my job. Told him I was now Sherlock Holmes. Asked about my new partner. I told Bing my partner used to be a duck and would be again. He wanted to know how I felt about that and I told him we got along rather well—even better after he was killed and came back as Dr. Watson. Asked me if I thought Norfolk would take the MCCA Knockout Trophy and I told him that would happen when Inland Revenue ran out of taxpayers. He told me I seemed to be doing much better. Patience of a saint, Dr. Ehrenberg.

Watson sat back, looked at me, and said, "The butler did it."

I glanced at him. "Astonishing. What ever led you to that conclusion?"

"Great heavens, man! It's right there under your nose. Look! The bounder's name is Moriarty! James Moriarty!"

I looked back at the list on my screen. "So it is." I frowned as I considered a detail that was becoming increasingly troublesome to put aside: The Moriarty business was only the latest symptom. It was just the sort of joke Shad might have made had Shad been in his feathers and in Watson's place at that point in time. It was also what the current Watson might have said had he been smoking proscribed substances or experimenting with having his brain perforated and filled with kitty litter. It wasn't just concern for my friend's sanity. Was it really safe letting him drive? I was wondering a bit about my own mental state, as well. I was rather getting into the Basil Rathbone Sherlock Holmes character. It seemed to me I was enjoying it a good bit more than Watson—Shad, that is.

The air corridor followed the Exeter Canal as it hugged the west bank of the Exe as far south as Turf where the canal ended. The river made a gentle bend to the east, and the corridor continued south over the farmland canals and greenery near the hamlet of Exwell Barton. Directly before us, rising from the greensward like some sort of medieval stone rocket gantry at the top of a gentle hill was Powderham Castle estate's triple-towered stone Belvedere. Vacationers waved from the crenellated battlements and Watson waved back. Beyond and below the towers, set among the trees in a deer park by a small lake,

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was the castle. Looking beyond the castle site was the wide avenue of the river, then Exmouth just below the curve of the ocean's blue horizon. White sprinkles of gulls flitted among the blues, greens, reds, and yellows of the sails and pennants flying on the sailboats filling the Exe. Watson pointed toward the boats. "Looks more fun than selling kitty litter, eh Holmes?"

"It appears so, Watson. Do you sail?"

"Sail? Heavens, no. Do you?"

"I'm ashamed to say I've never set foot on a sailboat. I suppose some day off we could take a lesson. Want to give it a try?"

Watson settled deeply into his couch and concentrated on the Sky Rover's instruments. "River looks very deep there, Holmes. Probably quite cold, too."

"Nonsense, old fellow. You'd take to it like a duck to water."

"Very amusing. Those things don't look safe."

"Sailing is like working around bombs, Watson: It pays to know what you are doing."

"I suppose we know where you and I come down on working around bombs, Holmes: A bit here, a bit there—"

"—A bit there, a bit here—"

"—A teeny bit way over there—"

"—And a great big gob or two down right here!"

We finally allowed ourselves to have a thorough laugh over that dark episode at Hangingstone Hill that was, after all, over—at least until the next echo.

Powderham Castle stood atop a slight rise in the well-tended and tastefully wooded deer park. We went once around it before touching down. The lake mentioned before stretched gracefully east and west just south of the castle giving that side of the building views of deer drinking from the reflections of ancient trees. The castle itself, although replete with crenelated walls, gates, and towers, looked to be more manor home than fortress. Still, it had seen its battles during the Civil War, fighting on the Royalist side. Norman towers, a mix of brickwork, cut gray stone, sandstone, carved beerstone casements, oak, and ivy made of it an architectural map of the centuries it had withstood since it came into the Courtenay family in the thirteen hundreds.

The Courtenays were not only respected in the west country but well liked. I doubt if there had been anyone living within a hundred kilometers of Powderham who hadn't, at least once in their lifetimes, visited the castle. Val and I had been there several times on tours and at events: once on a tour of the castle, once on a tour of the gardens, once on a nature walk, once as guests at a wedding, twice we went to catch the fireworks on Guy Fawkes Day. Even Shad and Nadine had been there, as Watson had narrated. A big jewelry heist among the guests at a Powderham paid occasion wouldn't ruin the Courtenays and probably wouldn't break any of the guests so robbed. It was not, however, the sort of thing needed right then by Ian Collier and his family. In any event, it was very rude.

Watson put us down in the skydock off Powderham Castle's North Drive. "Notice something about that castle as we came in, Holmes?"

"Many things, old fellow. Which did you have in mind?"

"Doesn't look a thing like Darlington in *Remains of the Day.*"

"Then perhaps we won't have Hannibal Lecter with which to contend. In any event, here comes the welcoming committee."

Since we arrived in an ABCD Sky Rover, one of Collier's off-duty constables advanced upon us from my side. He was a chunky fellow sporting a handsome gray handlebar mustache, a reflective silver and yellow traffic bib over his uniform. Since Shad had on his nineteenth-century Watson getup, complete with genuine houndstooth Sherlock Holmes deerstalker (a size too small)

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atop his head, a wedding party parking attendant advanced upon his side of the vehicle. This lad was also chunky, apparently from bench-pressing railroad rolling stock. He was wearing a midnight blue tuxedo with a candy-striped tie. Shad opened the windows, I showed my ID to the constable, but before I could ask for Collier's office, Watson asked of the attendant, "Grimpion-Meyer wedding party, please?"

The guide pointed to a slot, I bit my tongue, put my ID away, and Shad moved the cruiser toward the slot. We both held it in as long as we could, but mere flesh can bear only so much. Just as we locked into the slot we collapsed into each other's arms choking off cries of, "Grimpion-Meyer!" as best we could. As we exited the cruiser, the parking attendant and the constable seemed to be arguing. Actually, the attendant was upset, and the constable was attempting to calm him.

"What seems to be the problem, Constable?" I asked.

"Nothing, Detective Inspector. The lad's mistaken about something, that's all. Heard you and your partner havin' a laugh and he thought it might be at his expense."

"Not at all, my boy," I said to the fellow in the candy-striped tie. "The name of the wedding party, Grimpion-Meyer, struck us funny because of our resemblance to some fictional detectives in some very old vids: Sherlock Holmes and Dr. Watson." I took the deerstalker cap from Shad's head and placed it upon my own.

"What's funny about that?" demanded the lad.

"One of their cases, *The Hound of the Baskervilles.* Have you heard of it?"

"Of course. I attend Cambridge, don't I?"

"Cambridge College of Dry Cleaning," muttered Watson.

"What was that?" the lad demanded.

"The Hound of the Baskervilles," said Watson loudly, "took place near the Great Grimpen Mire."

The lad stared at us for a moment, then smiled on one side of his mouth, then the other, then he said, "Grimpion-Meyer," he laughed, and unpleasantness was averted. "One thing, though," the lad said to me as Shad turned and began walking toward the castle's north gate entrance.

"What is that?" I answered.

"I understand that Sherlock Holmes—not the one in the movies, the one in the stories?"

"Yes?"

"I understand he never wore a deerstalker cap. That was just something they done up in the flicks."

"Ah," I said placing an arm across his substantial shoulders. Solid fellow. "A popular myth that I am pleased to have an opportunity to dispel, lad. I believe you will find in Dr. Watson's account entitled 'Silver Blaze' the good doctor depicts Holmes's attire on their rail trip to Exeter. Watson describes his friend's face 'framed in his ear-flapped traveling-cap.' Now, among the available ear-flap caps in those times and later were any of the knitted, fur, and cloth winter affairs—Andes, Eskimo, aviator, Elmer Fudd, Omar Bradley, and so on. I'm certain you'll agree Sherlock Holmes would rather let Professor Moriarty make off with the crown jewels than appear in public in any one of them. Do you agree?"

"I'm not sure."

"Can you see Sherlock Holmes with a shotgun sneaking through the woods saying, 'Shhhh. I'm hunting a wabbit.'"

"I cannot."

"Good lad." I patted his back. "Sir, the rakish deerstalker is the only possible ear-flapped traveling cap sufficiently fashionable for Sherlock Holmes. Good day to you."

The constable nodded me toward the north entrance. By the time I had made my way through it into the courtyard, Watson was nowhere to be seen. I stood across from the castle's famous red door

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which, recalling the wedding Val and I had attended, was the main entrance for wedding participants and guests. I had a spine chilling moment thinking of Shad befuddled up as Dr. John Watson stumbling among the guests doing his best to solve the crime. Just before my blood turned to blueberry yogurt, I caught a movement out of the corner of my eye. It was a small door closing in a wall behind and to the right of the main tower. By the time I reached that door, it had closed altogether.

"Shad," I said in something between a shout and a whisper, "That's the wrong bloody door." He was gone. I opened the door to a dark sort of vestibule and entered, the aromas of prepared foods blending agreeably with the scents of old wood and new wax. I crossed hallways, rushed down passageways, and generally worked myself into a panic. I peered into rooms gingerbreaded with Italian molding, hung with portraits of ancestors, and festooned with Chinese glazed pots large enough to make a rather comfortable maisonette with the proper plumbing. I peered down hallways polished until everything seemed dipped in honey, more portraits of ancestors, polished brass candlesticks, and hoary crude tables that wore their polished scars with beribboned honor as though inflicted by shielding the body of the Conqueror himself. Thinking of Shad running loose in this movie set rechilled my blood to hypothermic levels.

By the time I managed to catch up with him, Shad was standing at the foot of a dark staircase covered with a blue runner, blue carpeting on the immediate landing, and more blue runner as the stairs continued up and to the right. On the back of the landing into the blue plaster of the wall was a hidden door to a set of servant's stairs. It strained memory but it appeared to be where the butler's father in *Remains of the Day* first showed that his squirrels were getting the better of him, as a duck I had once known might have put it.

Nigel Bruce, thoughtfully cocking his head to one side and tugging at his bit of a mustache, could have been right out of any of the Rathbone-Bruce series of vids. He glanced at me. "Oh," he said bluntly. "There you are, Holmes. Been looking all over for you. Where the deuce've you been?" He looked back at the stairs. "Look at this staircase. Not much of *Remains* was filmed here, you know. Never cared much for the character of Lord Darlington. Not a great role for Edward Fox, an actor I much admire, as you know."

"Yes."

"Much underrated in his time, Edward Fox. What a Nelson he would've made. Eh, Holmes?"

"A role for which any self-respecting British actor would gladly give his right arm, Watson."

He looked at me for a stunned five seconds before he continued. "Holmes, remember Fox's remarkable performance in *Day of the Jackal?*"

"Yes. Very exciting production."

"Was there anyone who saw that performance, Holmes, who at the conclusion wasn't rooting for the Jackal to shoot Charles de Gaulle?"

"Very true, Watson, but that may have been for other reasons besides Fox's performance."

"How do you mean?"

"As you may recall, *Day of the Jackal* was inspired by an actual plot to assassinate de Gaulle. It was said most Western leaders had his face on their dart boards."

"I see. Well then, how about Edward Fox's role as Leftenant Francis Farewell, the adventurer who came to South Africa to hoodwink a savage ruler and stayed to fall beneath the spell of the great Shaka, king of the Zulus?"

I could almost hear the mourning and the dramatically mysterious musical score as Dr. Watson lowered himself to one knee before the staircase. He still had his multitrack sound system pro-

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grams and databanks intact, if not his judgment. "As mournful chanting lows in the royal kraal, the reflections of the hearth flames flicker against the walls of Shaka's great house. Farewell kneels and listens as the great Zulu king bitterly throws the Englishman's deceptions back in Farewell's face. The leftenant tells Shaka that hating the English is not the solution, that they must search for the solution together. Shaka scorns the Englishman's words. He says that Farewell is a man with no nation, a shadow. The king tells him to go, that Shaka no longer has any need for him. Farewell answers:

"Go?" Watson cried loudly, doing a remarkably good Edward Fox. "Go?" he inquired again of the Zulu king as I heard a squeak come from the stairs above. "Where?" he demanded loudly and angrily as I spied with my little eye a sharply dressed fellow wearing a black tux with silver tie descending the stairs. Between a loosely blown array of silver-gray hair and the tie was the smoothly shaved, only slightly jowly face of Charles Hugh Pepys Courtenay, Earl of Devon. He was heading straight down the stairs for Shad's performance of Nigel Bruce's performance of Dr. Watson's performance of Edward Fox's performance of Francis Farewell's farewell performance before Shaka, as Shad's and my pensions joined *Pliopithecus* and the Dodo in existence's dustbin.

"Where can I go?" Farewell begged more humbly, a shaking hand extended toward the imaginary Zulu king. It was Oscar-winning stuff.

"Where I have been," answered Lord Devon in a deep, rich voice, doing a quite credible Henry Cele as Shaka.

Shad looked up the stairs, his eyes bugged, his cheeks bulged, and he struggled to his feet, spluttering apologies. Lord Devon placed his well-manicured hands together and clapped genteelly. "Well done, sir. *Shaka Zulu.* Well done." He nodded his gray mane at me. "Indeed, I am horribly late for the reception and I see the chief constable has sent England's most dynamic duo to track me down, wot? Holmes and Watson, wot? Basil Rathbone and Nigel Bruce?"

Shad and I exchanged quick panic glances. "Chief constable?" Watson mouthed. Facing Lord Devon, Watson said, "Just a gentle reminder of the time, milord. Could you direct us to the castle's head of security so that we may report our mission accomplished?"

The master of the house laughed, crinkled his eyes, and pointed down an ancestor-imaged hallway generally toward the south. "All of the way down there, doctor, last door on the right. Oh."

We both paused, frozen in mid getaway, giving Lord Devon our full attention. It was that kind of 'oh.'. "Yes, milord?" I said.

"Do you know if there has been any progress made concerning this dreadful jewelry matter?"

"Yes there has, milord," I said. "I am pleased to say it should all be cleared up before the conclusion of the reception."

"Not a theft, was it?" He pronounced "theft" as though its mere thought might endanger the very foundations of Powderham.

"A mere misunderstanding, milord. Nothing more. Please put your mind at ease."

His eyebrows ascended. "Excellent!" He nodded, his face wreathed in very happy smiles. "Jolly good." He looked at Watson, his face growing somewhat more serious. "Excellent actor, Edward Fox." He shook his head gravely. *"Remains of the Day.* Hated that movie as a boy. Don't mind me baring the old soul, do you old fellow, one actor to another?"

"Not at all, milord."

"Your excellent portrayal of Edward Fox reminded me of it. As a boy they told me a thousand times *Remains of the Day* was filmed here. Dreadful film. I even watched it once. Could hardly stay

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awake. I mean you practically stand up begging Emma Thompson to hop naked in Hopkins's tub, wot? Muss his hair a bit?"

"Quite," said Watson.

Lord Devon looked into a glass and darkly. "Away at school you tell all your chums the bloody thing was filmed at Powderham. They don't care the ruddy film's boring. It's Hollywood. Movies! With *Hannibal the cannibal.* You sit before the tellymax screen all puffed up, the ruddy thing begins. There it goes, sir, with that bloody ride up a hilly lane you never saw before and you pull up to a townhouse with a Georgian roofline decorated with bloody old urns. 'Where the hell is that?' shouts out Jimmy Brown. 'That's not Powderham,' says Cyril Danforth. 'Where's that, Charlie?' yells out Tommy Welles. "Where are the battlements?"

His lordship descended the remains of the stairs, clasped his hands behind his back, shook his head, and made his way toward the wedding party, still shaking his head. "Scarred me for life," he muttered as he turned a corner. "Bloody movies." Shad and I exited on tiptoe in the opposite direction.

"Now, was that a good save or what?" said my partner as we reached Ian Collier's door.

"Save? *Save?"*

He gave me his hurt Watson expression. "Of course, Holmes. Where's the head of security? Mission accomplished?"

"Shad, there *is* a built-in bumble factor in your Dr. Watson brain! It's the size of a casaba melon!"

"Really, Holmes!"

"You know what they call a firefighter who does a superb job of extinguishing fires he himself has ignited?"

"What?"

"An *arsonist!"* I knocked on the door and entered.

The security officer on duty led us to an office, which led to an outer office and a secretary who led us to an inner office overlooking the deer park and lake. It was a well-lighted room, smallish, and tucked about with family photos, professional photos, and neat shelves of books. Ian Collier himself was older than I remembered, a testimony to the dozen years or more that had passed since I had last seen him. He was a pleasant-looking fellow of about Watson's height, brown hair thinning on top and graying on the sides. He rose slowly behind his desk as we entered. He had a narrow face I hadn't remembered as mournful but which certainly rated such a description a moment before he caught a glimpse of the professional help he was getting from Exeter. The expression then became something between flabbergasted and crestfallen.

"Blood and sand, Jaggs! What's become of you?"

"I haven't time to explain, dear boy," I said briskly. I nodded at Shad. "Former Assistant Chief Constable Ian Collier, this is my partner, Detective Sergeant Guy Shad. Watson, this is Mr. Ian Collier."

"Pleased to meet you, sir," said Watson, extending his hand. They shook. Collier appeared to be waiting for an explanation I really had neither the time nor the heart to provide. Hence, I said, "Shad and I are traveling incognito."

"I shouldn't wonder," he responded. He gestured at two red leather-covered captains chairs facing his desk. "Please. Be seated. Can I offer you some tea?"

"Thank you. That would be most welcome," I said, lowering myself into the chair to Shad's left. As we waited for Ian's secretary to bring tea and biscuits, Powderham Castle's head of security briefed us on the missing jewelry. I noticed while he was talking, family photo images randomly appeared in a screen on the shelf behind Ian's head. Wife and two young sons perhaps ten and seven respectively. There was a single still of a golden retriever hanging on the wall opposite the desk. It looked as though it

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had been taken on a sunny day in a field of wildflowers. The tea was poured and I took my cup. Excellent blend, by the way.

"We need several things," I said to Ian. "First, as discreetly as possible, have several of your security personnel go to the reception, locate, and extricate Miss Betsy Blythe."

"The blind woman with the seeing-eye dog?"

I smiled. "She is not blind, and that dog is a Labradoodle bio with a human imprint. As soon as possible after grabbing them—"

"You said *extricate* them."

"With prejudice. Once you have them, separate them. Make certain you get both woman and dog and that they cannot communicate. I doubt that they'll be rigged with wireless, but be prepared for it just in case they are."

"Very well."

"Next, I need to interview Clarice Penne."

His eyebrows went up. "You mean Timmy the Tortoise?"

"Yes. I need to do so in private, with Betsy Blythe, and without the dog."

Collier was looking confused. So was Watson.

"Come now, gentlemen. Surely you can arrange a meeting. It must be near a place where we can have unobserved access to the ABCD cruiser."

Collier leaned back in his chair and crossed his legs. "There's a place just beyond the rose garden where you can have that meeting," he said. "At the east edge of the garden where it drops down to the dressage lawn there's a wall. It would conceal your cruiser."

"Excellent."

"Am I permitted to know what's going on?" he asked.

"I'm sorry, old fellow. It's like rescuing the troops from Dunkirk. If it had to be written up in triplicate and approved in advance, no one ever would have had the courage to take the responsibility."

Collier looked at Watson, who chuckled. "Holmes really knows how to lead a charge, doesn't he?" said my partner.

"Now that you mention it, the phrase 'the brave Six Hundred' does come to mind rather easily right now." Ian Collier shifted his gaze back to me. "I'm not going to find out you two have escaped from some asylum am I?"

"No. I don't believe you will ever find out." I touched my fingertips together and looked over them, my eyebrows arched, my eyes widened, but not crossed.

He leaned back in his chair, raised a hand in dismissal, and dropped it to the arm of his chair. "I can arrange for you, your cruiser, Betsy Blythe, and Timmy the Tortoise to meet privately off the edge of the rose garden. Anything else?"

"When you took that imprint of your dog, Ian."

The change of subject caught him off stride. Once his double take was done, he leaned back in his chair. "When I was forced to retire?" he asked, his face reddening.

"Yes. Do you still have that chip?"

He frowned. "Yes. It's here in my office."

"Excellent. We'll need that."

"Is that quite all?" he asked.

"No, not quite." I rubbed my chin. "We'll need a dungeon, a butcher's apron, some tomato juice, a rusty knife, and two of your most thuggish-looking cops. They must be reliable chaps, not squeamish, men who can keep their mouths shut. If the chief constable, the earl, or Superintendent Matheson get wind of any of this, the lot of us will be balls-up and most likely never play the violin again."

As gentle breezes touched the treetops, the warm spring air was filled with the heady scent of roses. A marquee for children's entertainments had already been erected at the edge of the lawn below the rose garden. Inside the marquee were a few chairs, Betsy Blythe, Ian Collier, Clarice Penne as Timmy the Tor-

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toise, Shad as Bruce as Watson, and myself somewhat in charge. The ABCD cruiser was parked out of sight of the castle next to the rose garden wall stairs. Collier and Watson stood guard by the stairs while I sat on the chair facing Betsy Blythe to my right and the tortoise to my left. Miss Penne, of course, as a thorn-thighed tortoise, had her head stuck out of a shell about the size of a smallish elongated dinner plate with warmer. Miss Blythe was somewhat more attractive being a shapely human female bio wearing a pale blue cocktail dress with white half-heels. She was in her mid twenties, brown hair with reddish highlights, a relaxed cupid's bow mouth, a bit of an upturned nose, and lovely hazel eyes once I removed her heavy sunglasses.

"A shame to hide those beautiful eyes, Miss Blythe."

"I'm sorry, sir. I don't know who you are. I'm blind, you see."

"Actually, I do see, Lolita, and so do you."

"My name's Betsy—"

"It's Lolita Doll, and you are no more sightless than am I. We are pressed for time, my dear. Therefore, may we dispense with the denials, explanations, excuses, and so on?"

"My dog—"

"We have Frank Statten in detention and caught red-handed—or red-pawed—with the goods. Because you tipped us off, we are inclined to be lenient."

She stood up and glared down at me. "Lolita Doll rats out *nobody,* copper!"

I held up a hand. "Please. Calm yourself. You all but sent engraved invitations. Now, take your seat."

She slowly sat down on her chair, still glaring at me, then looking down ashamed. "You helped me a lot, Inspector Jaggers. That's the truth. You and the parrot. Don't know what I would've done if I hadn't fallen into your hands. That Dr. Ehrenberg helped me, too. But how'd you know I had a partner in that Wallingford job? And how'd you know to come here to catch us?"

"Unintentionally, perhaps, but you told me both times, my dear. The parakeet was certainly too small either to hide or carry much in the way of swag. About all it could do was map out the security systems and get the codes when they were entered. You had to have a partner. Add to that you worked at Songbirds and we already knew Frankie Statten owned the shop, and there you were. Then when I heard a large jewel heist had gone down at Powderham and saw Betsy Blythe had brought a large dog, well, it was obvious that Lolita Doll and Frankie Statten were at it again."

"Sorry?" She was frowning at me.

"Betsy Blythe," I repeated. "Blythe from the Blythe doll created in 1972 by the American Kenner toy company and Betsy from the Betsy Wetsy created in 1934 by Ideal." I held out my hands. "'It's me, Doll.' Perfectly obvious."

"Remarkable," she said.

"At times I astound even myself. What were you trying to do, Lolita?"

She looked up at me, her eyes filled with tears. "See, all the ladies had these little changing cubicles set up in the room off the First Library where they could change before the reception and dance. Can't thunder rock wearin' all that ice. Mr. Collier there had folks they could leave valuables with, but most guests didn't bother. Frank was right about that. But a signal's supposed to go off when we returns to the shop. That's when we was all supposed to get nicked. I suppose this is all right for what it is, but it's only going to be attempted, isn't it? I wanted the whole book."

"I thought you wanted some place safe, Lolita, to be taken care of, to be happy and loved. You're not going to get that locked up in the nick."

"Half a loaf," she offered lamely.

"Is half a loaf short," I completed.

"It'd be almost worth it to think on Frank being miserable for a tenner."

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"Listen, Lolita. I believe I have the answer to all your problems and mine." I held out a hand toward the tortoise. "Do you know Clarice Penne?"

She looked at the tortoise and back at me. "Oh, sure. I mean I seen her here in the garden maybe a hundred times tellin' stories to the children, the tykes pettin' her shell and all. Every chance I get I come down here. I told Dr. Ehrenberg about it. So beautiful here."

"How would you like to tell stories to children, Lolita? You're good with lies and know the very best stories. How would you like Clarice's job?"

"Now you hold on just a minute there, Sherlock," said the tortoise. "This is *my* gig and for as long as I want it. I got a contract."

I reached over, picked up the tortoise, and whispered at Clarice as I faced her about. "If you pee on me, love, I will put you on your back for the remainder of the meeting and leave you that way." I aimed her snapping end at Lolita. "Clarice, look at Lolita, hush for a moment and consider: How would you like to have that face, that voice, that age, those legs, and that body as you reinvent yourself and relaunch your theatrical career? You'd still have all your current financial assets, belongings, degrees, whatever."

The tortoise was dead silent, but I could almost see the smoke coming off the top of its wrinkled head. Finally the tortoise glanced back at me. "Who the hell are you, mate?"

"Forgive me, Miss Penne. I am D.I. Harrington Jaggers, Devon ABCD."

The tortoise moved its head until it was once again looking at Lolita. Clarice said, "Would you consider it, girl, even for a serious second?"

"Oh yes! In a heartbeat!" she answered. "You have the most wonderful job in the world! Please!"

"Girl, you don't even know what my body in stasis looks like."

"I don't care," said Lolita. "I don't want that body. I want the one you're in now."

"I have your natural all taken care of," I said to Clarice. "Are we agreed, then? Lolita?"

"Safe, taken care of, happy, and loved. You remembered everything, Inspector. Is there nothing you can't do?"

"We'll see. Clarice?"

"I'd sure like to know how you read me so well, Sherlock."

"Elementary, Miss Penne. You are the only thorn-thighed tortoise in the United Kingdom on antidepressants." I held a hand out toward the cruiser. "Shall we? There is only a miniscule window of opportunity." Ian and Watson both hunched their shoulders, turned their backs, and faced the stairs.

I took Clarice and Lolita over to the cruiser, ran up the mechs, moved a few things out of the way, moved in one woman bio and one tortoise bio, swapped their imprints, and moved out one woman bio and one tortoise bio. Once that was accomplished the two of them went to a far corner below the rose garden wall to talk over some tortoise-girl, girl-tortoise stuff. As they were thus engaged, I sent the cruiser to the next location, the outside entrance to our improvised dungeon, and said to my faithful medical companion, "Come, Watson, come! The game is afoot!"

It was not a bad dungeon for our purposes. The space was below ground level, sufficiently dank, the walls of ancient dressed stone, the atmosphere musty. The room's past as a storage place for meats was evidenced by the number of rusty meat hooks protruding from two of the four walls. There were no grinning skeletons hanging from irons, but the castle's spider population had done a grand job of decorating the craggy beams above with filthy old webs. The lights were electric instead of smoky old torches, but the lights were grimy and adequately dim.

In the center of the room was a large wooden butcher's block table. Its dark

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uneven surface had seen much use over the centuries. The dips and stains testified to millions of cuts and oceans of blood. I stood at one corner of the table, Ian stood across from me. At the other two corners were two of Ian's men, Peter Blake and Henry Tompkins. They were both retired constables who did professional wrestling on the local circuit. With the proper makeup they had also appeared in several locally produced horror vids. They were wearing the proper makeup.

In the center of the table sat about the sweetest, most good-natured, lovable dog I had ever seen. He was about seven stone, his fur light brown, curly, and uncut, giving him both a ragged and fluffy appearance. Delightful face, with a few of those curls hanging before his eyes. The dog's name, according to his license tag, was "Doodles." His brace, peculiar to seeing-eye dogs, had been removed and was on the floor in the corner behind Ian. To all appearances he was a real dog, which meant his bio receiver was being shielded by a Bio Shack special. Doodles, poor fellow, appeared just a bit nervous.

"Gentlemen," I began, "While we're waiting for Dr. Watson to finish cleaning up from working on the two cats, please be so kind as to note the breed of this animal. This is a cross between a Labrador retriever and a poodle known to dog fanciers as a Labradoodle." I reached out and petted its head. "Good boy. Labradoodles are generally good natured, take complicated training extremely well, and are very remarkable in that they do not shed."

"Not at all, Mr. Holmes?" growled Peter Blake.

"Your allergic sensitivities are safe with this pooch, Mr. Blake. Now, as I remarked, they are easily trained and well behaved, which is why this animal's behavior quite puzzles me. There is only one reason I can think of why such a valuable animal should eat all that jewelry that was left in the changing room."

"How can you be certain he done it?" asked Henry Tompkins.

"Elementary, Mr. Tompkins. Staff security have searched everywhere else, have they not?"

"Aye, we have." The big man nodded his massive black-hooded head.

"And Dr. Watson has examined all of the other pets as possible hiding places, hasn't he?"

Ian, Blake, and Tompkins hung their heads. "Aye," said Tompkins. "He did that." I rather hoped they weren't overdoing it. I glanced down at the butcher block and there was just the right amount of tomato juice smeared about. The Labradoodle was looking down at the butcher block, as well. His tongue was out and he was panting.

"There you are, Mr. Tompkins," I said. "'When you have eliminated the impossible, whatever remains, however improbable, must be the truth.'" I looked into the dog's wide-eyed gaze and said, "Sir Arthur Conan Doyle." A rattle followed by a low muttered curse came from the shadows beyond the arched doorway. From beyond it Watson emerged wearing the butchers apron stained from the waist down with tomato juice. He wasn't wearing his tweed jacket and the sleeves of his white shirt were rolled above his elbows. His hands were stained slightly with red, but the butcher knife in his right hand was coated with the stuff.

"Told you the jewels wouldn't be in those cats, Holmes," he muttered through hurt feelings.

"We had to look, old fellow."

"Neither of them pulled through, you know. Wouldn't've hurt anything to let me hop into the village and pick up some anesthetic from the chemist's."

"We were pressed for time, old fellow. Sorry to put you through that."

He looked over the tops of his glasses at the assembly. "The owners of those cats are going to be quite distressed and it's no fault of mine. I objected to all those procedures from the start. I want

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that on the record." He snorted contemptuously at the butcher knife in his hand, which he began waving about. "Not even a proper scalpel. This thing's dull as an old rake. Do a better job with a chain saw."

"Couldn't be helped, old fellow." I reached out a hand and scratched the dog's head. "Here's the last one."

The Labradoodle's panting resembled a steam locomotive attempting to climb the South Face of Everest.

Watson's eyebrows went up. "At least this one is big enough to hold the jewelry, Holmes." He passed his thumb slowly over the knife's edge. "Strange looking beast, there. What kind of breed is that?"

I held out a hand to Peter Blake. "You may have the honor, Mr. Blake."

"Yes sir." He looked at Watson. "This here, doctor, is a Labradoodle."

"Labradoodle, you say? Well, there, stretch him out on the block boys and let's see if we can't separate his Labra from his doodles."

"All right! All right! Jesus, Mary, and Joseph!" yelled the dog. "All bloody *right!*"

We watched as the dog sat back on its hind legs, pulled its forelegs to its sides, and a line appeared in the dog's fine belly hair. The line parted starting at the top, and essentially unsealed spilling all of the missing jewelry into Peter Blake's quick hands. Watson moved to my side.

"Congratulations, Holmes. You nailed Frank Statten."

"Ah me," I said as I shrugged. "I'm afraid I'm going to have to disappoint you once again, old friend."

He frowned, then one eyebrow slowly elevated. "I don't believe it, Holmes. Not another catch and release."

"With a condition." I looked and saw I had everyone's attention, including the Labradoodle's. "Jewelry heist at Powderham Castle, right in the middle of a reception, famous guests, among them Lord and Lady Devon and the chief constable of the Devon and Cornwall Constabulary. The scandal would never do."

I looked at the dog. "Would it?"

He looked around, shifty-eyed. "No. No, the media would have a feast."

"So it seems to me the best thing is to return the jewelry to its rightful owners, no theft, no scandal, no harm done."

"That sounds cool." The dog held up its right paw, extended a toe and wagged it back and forth. "But, call me Mr. Suspicious, I see a big fat fishhook with my name on it."

"Whatever do you mean, sir?"

"In return for this generous offer, Mr. Holmes is it?"

"Yes."

"In return, what's Frankie Statten's bill?"

"Why, I'm so glad you asked that question, Mr. Statten. We keep the jewelry, return it to its owners, and return you to your natural body in Exeter no harm done—"

"—And?"

"And that's it. We keep your equipment, of course."

"Equipment?"

"The bios."

"All . . . Lolita. She ratted me out."

"It's only because of her you're getting this deal, Frank," I said. "We've detained her and she will be spending the rest of her life behind walls." I pointed at the velvet-lined interior of his belly cavity. "We knew it was you all along because your gut was the last place there was to look. What about the deal?"

"You just let me go?"

"Once we get you back to Queen Street and Songbirds. Is that where you keep your natural?"

"Yeah."

"Do you need to be counseled on how much time you could draw doing things your way?"

"There has to be a catch." The dog looked down and shook his head.

"Must be disappointing for you, too, Holmes," said Watson to me, as Statten pondered the deal.

"Why do you say that, Watson? I would call this a most satisfactory con-

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clusion to this matter."

"Here you have a dog and you never got to say anything about the curious incident of the dog in the nighttime."

"Nighttime? There was no nighttime."

"Wasn't that what was curious?"

"Wasn't what—I don't quite see what you are driving at, Watson. I thought the curious incident was that the dog wasn't barking."

"Well, this dog wasn't barking. Didn't you find that curious?"

"Not in the least."

He leaned back. "Not even a smidgen?"

"Dear fellow, this Labradoodle is an amdroid imprinted by a human impersonating a very well-trained, well-behaved seeing-eye dog. Why would he bark?"

"Well, I thought it curious."

"Really."

"Game's afoot and all that—"

"I agree to the deal," interrupted Frankie Statten. "Just so I don't have to listen to any more of this rubbish!"

"Thank you." I turned to Watson and smiled. "Well done, old fellow. Well done. So, while you clean up and Mr. Blake and Mr. Tompkins discreetly return the jewelry to their respective owners, Mr. Collier, Mr. Statten, and I shall repair to the cruiser and sort out a few final details." I held out my hand toward the stairs. "Gentlemen."

As I followed Collier and the dog up the dungeon stairs, I heard the Labradoodle ask him confidentially, "This Holmes and Watson thing those two got going. An act, right? An act?"

"I don't know," answered Mr. Collier. "I simply don't know."

The cruiser rose from Powderham Castle in an arc that took us over the River Exe, giving us a good view of Lympstone's Bay Tower red in the afternoon sun. I could see Mama Bimbo's Cat House on The Strand being fitted out for some other kind of shop. A flight of gulls crossed below us and made wing for chips or fingerlings, whichever were more plentiful as the tide changed. Watson put us on autopilot and settled back in his couch.

"Holmes, what about Frank Statten and Songbirds?" He pointed toward the mech chip in the envelope on the dash clip. "Are you simply going to let him go without even a day in court?"

"I am going to take this chip to his stasis bed at Songbirds, update his natural, and leave, inquiry closed."

"Memories of every crime and crooked deal Statten ever pulled, everything he has in the works right now, is in his memory recall bank. I cannot believe you won't at least make a copy of that chip for the constabulary."

"I won't do it for two reasons, Watson. First, I gave him my word. Second, I don't think Statten will believe either that I won't copy his memory. Unless I'm terribly mistaken, every iron he has in the fire will be yanked out within hours of getting his engrams back into his nat. The deals he has going with any number of undesirable personages will be cancelled, and they will be after him to know why. Think he'll stick around to try and explain how he had to make a deal with Sherlock Holmes and Dr. Watson?"

Watson chuckled. "Not much to show on our records, though."

"Small price to pay for ending a one-man crime wave and doing a good cop a favor, don't you think? It should make absolute excrement of Frankie's criminal life and reputation, which will settle his account with Loretta nicely."

"I suppose." We rode along silently for a while, then Watson said, "Holmes, what is going to happen to Clarice Penne's body—the one in stasis? Sooner or later the owner of the stasis bed is going to have to put the body up for payments due, correct?"

"I'm surprised at you, Watson," I said. "Surely you recall our visit to that fair seaside cultural center you insisted on pronouncing Limp-stone."

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"Yes." He nodded. "Of course I remember."

"Do you also remember the woman who constituted one hundred percent of the clientele of Mama Bimbo's Cat House?"

He chuckled at that. "Yes. Petting Place. Absurd name. Maddie girl, she was. Madeleine Wallingford. She brought in the hapless jewel thief now inhabiting Timmy the Tortoise over at Powderham Castle. Our first catch and release. What of her?"

"Remember the card Madeleine Wallingford had us place in the shop window? The one for the meeting of the Order of St. Trinians?"

"Vaguely. Theater group, wasn't it?"

"I'm shocked, Watson. Absolutely shaken to my very nucleus. An old movie buff such as yourself? You yourself remarked how Clarice Penne's natural body resembled actor Alistair Sim, he who in his heyday played the headmistress of St. Trinians girls' school in *The Belles of St. Trinians* to such perfection—"

"The Order of St. Trinians," Shad interrupted. "That theater group does scripts based on the Ronald Searle cartoons!"

"Indeed, old fellow, indeed. Madeleine Wallingford is paying off the stasis estate agent and collecting the suit for Trinians new star performer as we speak. You know, possibly going without a proper hat has chilled your brain, depriving its cells of much needed oxygen, increasing your brain-bumble factor." I reached back and took a round box from the hands of the large walking mech. "In return for our services, I received this from my friend Ian Collier." I handed it to my partner.

"I didn't know we were allowed to accept gifts, Holmes."

"Nothing of value. This is just an old hand-me-down of Ian's grandfather's. It ought to keep your brain toasty."

He lifted the lid from the box, placed it aside, opened the tissue paper, and took the gray homburg from it. "Why . . . why this is quite thoughtful, Holmes." He placed it on his head with both hands and faced me. "How do I look?"

"Very handsome, Watson. Distinguished. The very picture of Dr. John H. Watson."

"You shouldn't have."

"Why not?"

His face grew long and troubled. "Now, this makes me feel terrible."

"How so, Watson?"

"Well, I've noticed, Holmes, that you seem to be enjoying our Holmes and Watson thing quite a bit more than I have."

"I'd noticed it myself. Now that I reflect upon it, I haven't felt this perceptive in decades. I feel as though I could untie the Gordian Knot one-handed, blindfolded, and play multiple games of championship chess with my toes at the same time."

"Feeling rather sharp, eh, Holmes?"

"As a tack, dear fellow. Why?"

"I have a confession to make. You know how I dislike reading instructions of any kind."

"Quite. As I recall DS Guy Shad's famous dictum: 'If the damned program or machine isn't intuitive to operate, it's crap.'"

Watson chuckled. "Yes. Very amusing."

"Come, Watson. What about it?" I prompted.

"Brochure came with my Watson suit, you know, from Celebrity Look-alikes." He reached into his side coat pocket with his left hand and pulled out a leaflet folded into thirds. "You were correct, Holmes, about what you called my bumble factor. There's one built in. Slows things down and fuzzes up thoughts while mixing them in with the vocabulary, vocal mannerisms, and so on of the Nigel Bruce Watson." He waved the leaflet idly in my direction. "Something else, too."

"What's that?"

"Bit of a cost-cutting measure, I fear.

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Makes sense if you look at it from their end. Celebrity Look-alikes, that is. You see?"

"I'm afraid I don't see. What are you talking about, Watson? What cost-cutting measure?"

"Oh. Well, usually both suits are rented at the same time: Holmes and Watson. You see? Symbiotic relationship."

"Ye-e-es," I answered warily.

"They had to have the Nigel Bruce as Watson suits made, you see. For the Basil Rathbone as Holmes suits, though, they simply used the same model fallen officer replacement suit that you have yourself."

"That makes perfectly good sense. Why reinvent the wheel?"

"Exactly, Holmes. So you understand."

"Understand what?"

"When my Watson suit came in close enough proximity to your model suit, my Nigel Bruce-Dr. Watson bio program asked permission to insert a wireless patch through your bio receiver. You must have seen it. You agreed to the terms."

"Ever since I went wireless I must get a half dozen of those things a day. I never read them—who has the time? What—well, what does it do?"

Watson yawned, tipped the homburg over his eyes, and slid down in his seat. "Only some mannerisms, vocabulary choices, thought pattern adjustments. According to the brochure it should sharpen up your thinking a bit. Seems to have done just that. Gordian Knot and all. We can uninstall it, I suppose."

"Why would I want to?"

"Perhaps I should. Don't quite seem to understand what's going on."

I picked up the brochure and gave it a quick scan. It had an address that would be useful in finding out if it would be possible to dial back Watson's bumble factor. Something else, too, that might be a problem:

The Holmes and Watson duo are only for entertainment, guys! Silly us! So if you run into real emergency situations while occupying these bios, programming automatically calls the chaps who are the real professionals. For anything less than emergencies, programming restricts your problem solving strategies to those not involving arrests or otherwise burdening the police. Have fun! And please solve crime responsibly.

That opened all kinds of possibilities. A few dozen Holmes and Watson duos on the streets could put the constabulary out of business for good.

"Speaking of bumble," said Watson, "I used to have a bumble dessert thing when I was with New England Wildlife. Quite tasty. Bumble brain pie."

"Doesn't sound very appetizing, old fellow."

"What? Sorry." He chuckled. "Misspoke there. Bumble brain pie. Silly of me. Actually it was called bum berry pie."

"Bum berry pie? Are you certain?"

"Yes. Raspberries, blueberries, blackberries. Delicious. A Maine favorite. Woman in Farmington used to make it up special for the officers in my station."

"Terribly sorry, Watson. Bum berry pie sounds even less appetizing than bumble brain pie."

"Bumble berry pie, Holmes," corrected Watson. "Whatever are you going on about? I said bumble berry pie. Keep going on about bum berry pie and you'll make people wonder from where you got this great reputation." He chuckled again and yawned. "Bum berry pie. You amaze me, Holmes. You absolutely amaze me. Oh, about the dog—"

"Frankie Statten was caught going equipped, hence the equipment is forfeit."

"I see that. But since—how was that again?"

"Since we are all agreed that the jewelry was misplaced and not stolen, there was no crime. Hence, no need to produce anything back at the office."

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Watson grunted something.

As the late afternoon countryside sped beneath us, I looked back over my thoughts of the past few days, thrilling at always having an answer almost as soon as a question arose. Such as, if I am heading east toward Exeter late in the afternoon, why is the setting sun not at my back but is, instead, perpendicular to the vector of motion and warming my left cheek? I looked at the GPS.

"Watson, you have us heading north toward Exmoor. Watson?"

I caught the sound of the old fellow gently snoring, took over the cruiser's controls, and entered the correct heading, wondering if the patch I had automatically accepted into my neural system included the ability to play the violin and an addiction to cocaine. Then I remembered my Holmes was a Basil Rathbone Hollywood Holmes whose strongest addiction was to whatever tobacco was stuffed into that huge meerschaum pipe of his. I needn't worry about smoking. Neither my lungs, my wife, nor the clean air regulations at Heavitree Tower could tolerate any of that nonsense.

My partner was having a bit of bother about the Labradoodle. To wit: had we stolen it? I suppose a case could be made for it, and I would be happy to meet Frankie Statten in court any time he wished to settle the matter at law. Once I was on the proper heading for Exeter, I settled in and contemplated blowing bubbles from that meerschaum. It went very well with the image playing before my mind's eye of Ian Collier, his wife, and two boys at Powderham playing with their old golden retriever in his new Labradoodle suit.

(EDITOR'S NOTE: Earlier adventures of Jaggers and Shad include "The Good Kill" [November 2006], "The Hangingstone Rat" [October 2007], and "Murder in Parliament Street" [November 2007].)

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The Merchants' War, Charles Stross, Tor, $24.95, 336 pp. (ISBN: 0-7653-1671-4).

Patrimony, Alan Dean Foster, Del Rey, $23.95, 231 pp. (ISBN: 0-345-48507-6).

Hurricane Moon, Alexis Glynn Latner, Pyr, $15.00, 403 pp. (ISBN: 978-1-59102-545-0).

The Guardener's Tale, Bruce Boston, Sam's Dot Publishing, $19.95, 274 pp. (ISBN: 1-933556-78-1).

The Dog Said Bow-Wow, Michael Swanwick, Tachyon Publications, $14.95, 295 + xiv pp. (ISBN: 978-1-892391-52-0).

Rumors of War and Infernal Machines: Technomilitary Agenda-Setting in American and British Speculative Fiction, Charles E. Gannon, Rowman & Littlefield, $24.95, 311 pp. (ISBN: 0-85323-708-5).

Science Fiction and Empire, Patricia Kerslake, University of Liverpool Press (order from University of Chicago Press), $75.00, 217 pp. (ISBN: 1-84631-024-5).

Charles Stross's **The Merchants' War**—fourth volume in the Merchant Princes series that began with *The Family Trade* (reviewed here in April 2005)—ends far too soon. After a long build-up, with great events and enormous kerfuffles thoroughly foreshadowed, it settles one small problem and leaves the reader panting for the next volume. Good marketing, I suppose, but annoying.

It all began when ace investigative reporter Miriam Beckwith discovered that she was the heiress to a clan of folks with the unique—they think—ability to step from one world (ours) to another (the medievaloid Gruinmarkt). This clan has grown wealthy by running drugs around borders in our world and providing rapid communications in the other. Miriam is a woman of modern Western culture. She is tough-minded, independent, and competent, and when she sees an opportunity to revamp an economically unstable enterprise (drug-running collapses if anyone wises up enough to put drugs on a legal prescription basis) by importing modern inventions (such as brake pads) into a third world, she grabs it. But the Clan is very hierarchical, part of a traditional culture where women just aren't independent beings. She must be brought to heel, married off, and set to making Clan babies. She was working around all that when the Clan turned out to have factions, both overt and covert. Not only that, but the non-Clan nobility of the Gruinmarkt had its own politics. Miriam discovered a scheme to enlarge the Clan with the help of a fertility clinic and was clapped in solitary (and visited by a Clan doctor) until she could be betrothed to the idiot prince who was the heir to the throne. The betrothal was under way when the prince's brother Egon, known as the Pervert, staged a murderous coup.

Meanwhile, Matthias, a highly placed aide who had been conniving with an estranged branch of the Clan, decamped to our world, planted a suitcase nuke in Boston, and started talking to cops, who promptly started raiding Clan depots

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and catching drug-runners. Homeland Security, FBI, CIA, NSA, *et al.*, promptly jumped in and mounted a raid on the Gruinmarkt (using captive world-walkers as porters) just in time to be on hand for the coup.

The Merchant's War begins in the immediate aftermath of the coup. Egon is mounting a war of extermination against the Clan and its supporters. Miriam is fleeing to her world three and trying to reestablish contact with allies despite efforts of the local secret police and unknown pursuers, presumably Clan members eager to return her to captivity. The Clan is discussing how to deal with the crisis and who to put on the throne once they have Egon out of the way (don't forget the doctor who visited Miriam in solitary). US security forces are hunting for a bomb, staking out Miriam's old haunts, and setting the quantum-physicists to finding a technological work-alike for the Clan's biological talent. The Clan is also setting one of its bright young men (from MIT, yet) to investigating the knotwork design that world-walkers must focus on to do their magic. Different designs lead to different worlds, and the Clan now wants to know if there is a system to the design and its variations. Before long, bright-boy discovers a world in the grip of an ice age with old ruins that speak of technology more advanced than our own. There is also a closed door just waiting for some idiot to open it. (Remember the hunt for a technological work-alike—of course there will be one.)

Meanwhile Egon is setting a trap for world-walkers. The Clan is preparing to step into the trap. Homeland Security *et al.* have tracked the Clan to its staging ground in our world and are standing outside demanding surrender. Miriam is discovering that she is in a biological bind, and her mother's emissaries are trying to set up lines of communication with the US government.

In other words, Stross has spent three volumes carefully filling his hat with assorted paraphernalia. Now he has tossed everything into the air. Some trajectories seem predictable, but the reader has to trust Stross to catch and juggle and finally set everything down safely in the next volume. Or the one(s) after that. There's no telling how long he can keep the juggling going!

I'm hooked. If you've been buying these books, you must be too. I just hope he'll get the next volume to us soon!

Alan Dean Foster has set his long-running (since 1972!) hero Flinx a cosmic task. There is a wave of evil appetite heading toward our Galaxy, intent on devouring everything, and Flinx must find the ancient Tar-Aiym Krang weapons system, which alone may win the day. Everything, but everything, is up to Flinx. But Flinx has issues: he is the product of a banned gengineering experiment. The experimenters have long since been hunted down and killed. The records are missing. He thinks he knows who his mother was, but his father is a mystery. However, a dying man's last words tell him his father exists and points toward the world of Gestalt.

So the cosmic mission must be put on hold for **Patrimony**. Flinx hares off to Gestalt, a chilly world whose stinky natives (they have no sense of smell) get along just fine with immigrants of other species. After a bit of detective work, he finds a possibility and arranges a long trek with a native guide to interview the fellow. At the same time however, a vicious bounty hunter discovers that the Order of Null will pay handsomely for proof that Flinx is dead and realizes that Flinx is close at hand. And so the usual sequence of frying pans and fires begins. Flinx of course survives—he has to, for Foster has one more book to go. He also learns something of his past and himself and falls briefly into an identity crisis.

Foster's sense of story is adequate unto the task, especially for fans of the

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series. But his writing is uninspiring. His prose is simple but also verbose, a combination that proves leaden, and when he grasps for cuteness, he fails. For an example, consider "Not wishing to have to pause in his journey in order to clean the skimmer's canopy, Flinx was relieved when the hlusumakai [an attacking predator] blew up well off to the craft's starboard side instead of directly overhead." According to this the wish preceded the relief, but in anything resembling reality, a character in such a rushed life-or-death action would feel relief and then—maybe—think something like "Glad I don't have to clean the canopy!"

He can do better, as in *Sagramanda*. I wish he had done so here.

One of the classic SF story-templates begins with the launch of a colony ship from Earth, fleeing political chaos or tyranny or environmental collapse. The ship of course finds a life-bearing world, though it may have odd quirks of weather or biology, and the colonists—with struggle, of course—establish their colony. At that point, there are several possibilities. A ship from Earth arrives, perhaps bringing the tyranny the colonists thought they had escaped. Or aliens show up. Or they discover intelligent life on their world. Allen Steele stirred all three into the mix with the *Coyote* series.

The template allows some variation, to be sure, but it is still a classic template. And Alexis Glynn Latner's **Hurricane Moon** fits it very nicely. The ship is the *Aeon*, and it is fleeing an Earth in crisis, both political and environmental, with some 10,000 colonists in coldsleep stasis. The target world is three centuries away, and it is known to have a suitable world, complete with a moon. Before it leaves, Catherin Gault is interviewing one last passenger, Joseph Devreze, a Nobel-winning genetic engineer who is both arrogant and handsome. She accepts him, and it turns out to be a good thing she does.

Three centuries later, Catherin and the rest of the core crew awake to learn that Earth fell silent sixty-nine years into the mission. Stasis failed in part of the ship, and hundreds of colonists are lost. The target world is there, but it has no moon because a wandering binary star swiped it. And the reader is told that the longer stasis goes on, the greater the risk of genetic damage. Should they stay and make the best of what looks like a bad deal? Or go on, traveling another seven centuries to find a better world and risk the stasis damage?

You can guess the answer. The next time they wake, a green world is in front of them, with a moon of about the same size, covered with water except for a curiously regular scatter of islands, and wreathed in hurricanes. Repairs to the ship are in order, and there is a clear need for someone who can tinker with genes to set right the stasis damage. So they wake up a few of the passengers, including Joe, who, being arrogant, is a difficult person to be around. He does *not* want to spend the rest of his life fixing people! He'd rather play gene-hacker, making things like dogs with flippers—sea-dogs—as he did on Earth. But man-grows-up is another classic trope, not just in SF, so you know what to expect. You also expect him to get together with Catherin (even if you didn't read the cover blurb), which makes this an unusually character and relationship-focused novel for SF.

As for the aliens . . . Well, I have to leave something for you to find out on your own, don't I?

Bruce Boston is best known as one of the premier poets of science fiction and fantasy. He also does short fiction and has the novel *Stained Glass Rain* to his credit. Now he adds another novel, **The Guardener's Tale**, in whose future environmental disasters have rendered much of the Earth unlivable. But in at least one place, civilization has con-

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densed anew in the form of a city ruled by bureaucracy and regulated by "guardeners," who assess the mental health and stability of citizens by means of Cybernetic Behavioral Analysis or cyberscan, which renders one's psyche in the form of a bundle of lines and nodes. In healthy, stable citizens, the bundle takes the form of a flower. If it doesn't, the guardeners have tools with which they can make adjustments, suppressing all individuality. When that doesn't work, the solution is generally exile to work camps. The end result is society as a garden of uniform flowers, carefully tended with the noble aim of growing the Perfect Future.

The very thought makes me shudder! But of course not everyone can be a sweet little well-adjusted flower. Richard Thorne is like that. He has a job, a chosenmate, an apartment in a nice clean district of town, and Tuesday nights free to go out on his own and get drunk or visit a courtesan. Or . . . Well, he finds himself visiting a remnant slum, where the bars are seedy and the courtesans are frankly whores. Then an acquaintance from work takes him to meet his half-sister, daughter of a long-suppressed anti-utopian revolutionary. She has actual books on her walls, uncensored, unexpurgated. She has a *horribly illegal* personal computer terminal. Richard gives her her price of booze and cash and is very promptly enchanted. And as he reads her books and learns the charms of being an individual, his flower becomes a distorted weed, at least according to the guardener, Sol Thatcher, who is writing this account in an effort to understand how such weeds can be. Alas, such writing is rather too individual for the Perfect Future, and it has strange effects both on Thatcher and—just perhaps—on the future of civilization.

Boston's future civilization is a communist's wet dream. His aim appears to be to say that it must remain a dream, never reality. Great effort can go into getting everything right, but people resist being crammed into pretty little flowerlike molds. That resistance leads to cracks in the facade of perfection. Ultimately, it forces change, perhaps for the worse, perhaps for the better. Either way, weeds (as defined by the guardeners) will flourish, will "rise up from the fields," he says on the next to last page. The garden will wind up in a more chaotic state. We might even say it will go back to nature.

An interesting item. Worth a look.

Michael Swanwick is as reliable source of reading pleasure as can be found anywhere, in or out of genre. I was therefore very happy to find **The Dog Said Bow-Wow**, a collection of delightfully warped Swanwick tales, in my mail. The title tale (and a couple of others) feature a pair of classic scalawags, Darger and Sir Blackthorpe Ravenscairn de Plus Precieux, a.k.a. Sir Plus or Surplus, who are constantly trying to con their way to wealth in a world that has banned all computers, replacing them with bioengineered monstrosities such as the current Queen of England. Their possession of a modem leads to no end of trouble!

You will also find here such classics as "Triceratops Summer." All in all, an excellent addition to anyone's collection!

Future war stories come in several flavors: warnings of coming conflagrations, jingoistic "get 'em first" tales, and what we might call "war-porn," bloody action for the sake of bloody action (video games, anyone?). All three can be near-future or far-future. The former may publicize weaponry that is relatively unfamiliar to the general public or that is just emerging from the lab. The latter invites the writer to stretch the imagination toward the limits of known science (how about black holes as projectiles?). Rarely do any serve as genuine prophecy, even when the writers try hard to get things right. But they can

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prepare the public mind for future wars by identifying and vilifying an enemy or getting people used to inevitable changes in tactics and prices of technology, in lives, and even in "collateral damage." They can also mirror politics by justifying policy or by criticizing it.

That's nice, you say, but that "prepare the public mind" business seems to presuppose that the public reads the stuff, and the SF readership is in decline. But there are still movies and video games, and as for readership, there was a time, Charles E. Gannon tells us in **Rumors of War and Infernal Machines: Technomilitary Agenda-Setting in American and British Speculative Fiction**, when a novel such as William Le Queux's *The Invasion of 1910* (1906) could be written to express a fever-dream of teutophobic conspiracy, be serialized in a newspaper, get discussed quite favorably in Parliament, and wind up claiming (arguably, admittedly) credit for predicting and preparing the ground for World War I. It missed important things such as trench warfare, but it got other things right and even managed to foresee how some technological shifts would play out in the more distant future of World War II. It also allows Gannon to say that this was an age when the modern superpower states were finding their feet and developing familiar tactics of "active information management, opinion formation, technophilia, and ideological cooption of popular discursive forms." In addition, superpower states "aspire to create their own future—and they frequently imagine, design, and rehearse it through war fictions that envision bold new technological advances and the socio-political revisions they might impel."

Later he notes that "traditionally, war narratives have woven ruminations on ethics, morality, politics, ontology, and even religion into their depictions of combat." Today there is much less of that, especially in movies and video games, which draw a much larger audience than print. The focus is on rapid-fire destruction and percussive special effects. The justification for violence is a given and the hero is little more than a gun on legs. About the exceptions, largely textual, he says, "at their most subversive, future-war fictions are, ultimately, challenges to our cultural traditions and values." The implication is that those future-war fictions that are not exceptions do not challenge our traditions and values, and that is a frightening thought. It is also a thought that is not unknown abroad and has a lot to do with why the United States is distrusted, feared, and/or hated.

Gannon is neither an SF writer nor a technologist. He's an English professor, and his book is couched in the patterns and terminology of literary criticism. If you are of a mind to give less credence to the humanities than to the sciences, set that aside long enough to read *Rumors of War*. I think you'll be glad you did.

Patricia Kerslake can say some things so astonishing—such as "Just as a blue light is not visible in a blue room"—that I struggle to resist the temptation to wax rude at her expense. Other temptations to resist arise when she buries her points in litcrit jargon and "postcolonial" cant so dense as to obscure clarity. But she still manages to be worth mentioning here. **Science Fiction and Empire**'s premise is that science fiction—the "literature of the *agent provocateur*"—is a variety of sociological laboratory in which some writers perform thought experiments to examine possible futures. "SF produces . . . an unending succession of literary experiments, each one examining a small part of a much larger image and each equally necessary to the greater vision. In order to analyse such experiments properly we need to reason in the manner of scientists and to use contemporary theory, both literary and social, as a tool in the investigation." Her focus is the role of empire in SF, and though as a scientist I

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can easily object to saying that literary theory has anything to do with thinking like a scientist, she still comes to some interesting conclusions, including that although "We are all products of the historical imperial project" SF is only partially bound by what its writers know of history or how history has shaped them. Extrapolation and experimentation mean that SF "is not completely determined by the ideology and culture of the time of writing. It is both connected and free."

I am sure that more literary folk will get more from the book than I. ■

IN TIMES TO COME

Our March issue features "The Spacetime Pool," one of the versatile Catherine Asaro's unique blends of colorful setting, engaging and memorable characters, mathematics, romance, and science fiction that may (temporarily) look to the inattentive reader like fantasy. I can't tell you much more than that without giving too much away, but I'm confident that you'll find it thoroughly satisfying and thought-provoking.

Stephen Baxter's fact article is about a world a little closer to home. "Project Boreas" describes the vision hatched by the British Interplanetary Society (with Baxter's active participation) for a manned base that might be built at the Martian north pole in three decades or so—and it looks intriguingly worthwhile and doable.

Speaking of Mars, we'll also have Part 2 of Joe Haldeman's novel *Marsbound*, as well as a mixed bag of stories by Robert R. Chase, John G. Hemry, James C. Glass, and Howard V. Hendrix.

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BRASS TACKS

Dr. Schmidt,

Your March '07 editorial on new writers had a different effect on me than it did on Larry Cohen (Brass Tacks). As an aspiring writer, it caused me to become conscious (and critical) of the quality of the stories printed in *Analog* and *Asimov's,* and to try to determine the factors that resulted in their acceptance. My background was in scientific writing which has exactly the opposite goal from recreational writing. (Operating instructions for a chemical process must be unequivocally clear and precise, or several types of disaster may occur.)

I can now identify interest-capturing first paragraphs, smooth dialog, coherent story line, and logical conclusions, as well as just plain skilled writing. Some writers stand out as real "wordsmiths" but others are more mundane. It isn't hard to distinguish slight differences in writing style within a story written by two authors.

In the July/August issue, I was astonished at the breadth of knowledge displayed by Michael Flynn, with an excellent alternate history followed by an erudite discussion of the same subject. Richard Lovett's "Weathermen" was not as interesting, but was well written as usual. Cramer's "Alternate History" was mind-boggling and *very* thought provoking. "Loki's Realm" was a good story, but it was obvious when either Lowe or Nordley were writing. "Jimmy the Box" was cute, "Bringing It All Back Home" funny, and all the others satisfactory.

"The Caves of Ceres" bothered me from the very first page, because the style of writing is what I call "Herky-Jerky." It did not flow smoothly from idea to idea, and the author seemed to insert dramatic phrases just to impress the reader. If I were grading such a story, I would have given it a C+ and suggested ways to improve it. Furthermore, by page two, it was obvious that the hero was going to have an affair with an attractive female he met. Nothing wrong with that, but I immediately wondered if this was another hackneyed story by Bud Sparhawk, writing under an assumed name. Not until I turned the last page did I find that Joe Schembrie was a different person.

One of my pet peeves is the increase in the number of fantasy stories in science fiction magazines, some of them not even good fantasy. Hopefully, that will never be a problem in *Analog.*

Bob Stanton

Hi Stan:

I think that it was in 1962 or 1963 that I first subscribed to *Analog* and found that it generally matched my need for airplane entertainment and regular thought provocation. I saw the format changes and the evolution to the double-issue era (ten issues for the price of twelve) with no real comment, but since I tend to save up issues for long periods (the record, I think, is over a year's worth) I am only now getting around to reading the July/August 2007 issue. Specifically, it seems that you owe the readers a replacement for pages 10 thru 61, which seemed to me to be pretty much a waste of ink.

I have rarely had trouble getting into

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an *Analog* story, but in this case, the first five pages didn't help at all as there appeared to be no story there. Giving that up as a lost cause, I went to the next piece, a science fact article. That was a little better, but appeared to me to suffer from the same style problem as the earlier story. It was an interesting question/answer format, but still seemed to be stuck in the 15th/16th(?) century and held no attraction at all to go past the first two pages.

Just a data point for you, as I generally really enjoy the magazine cover to cover.

Tom Thompson

Thanks for the comments. I'm sorry you didn't like those pieces, glad you like most of the rest of what we do, and especially glad you recognize that your dislike of the pair of items is "just a data point." Too many people don't seem to realize that when they say something is a "waste of ink," all they're really saying is, "I didn't like it." Quite often a piece that some readers hate, others will love (and vice versa). That was certainly true in this case—and if you think the article "seemed to be stuck" in an earlier era, I suggest you read the "In Time to Come" in the June issue, which explains why *it was quite deliberately written that way.*

Dear Stan,

This story ("Caves of Ceres," July/August) had me unconvinced about stalactites and stalagmites being present in caves in Ceres.

I'm not a geologist, but I used to do a lot of exploring in limestone caves.

Limestone is formed from the skeletons or shells of marine creatures, deposited over millions of years. Then the limestone sheet is raised above sea level, and rainwater (with a bit of dissolved carbon dioxide—i.e. carbonic acid) can dissolve the calcium carbonate. If the solution drips from the ceiling, some of the CO_2 evaporates, and the $CaCO_3$ comes out of solution, forming a stalactite. What lands on the ground below forms a stalagmite.

Now, how can this happen on Ceres? Unlikely to have had an ocean, marine creatures, or an atmosphere where rain with CO_2 falls. There is a comment in the story ". . . for mineralized water to drip, the cavern must have been pressurized and warmer, once." But I think it would have needed a lot more than this!

Gypsum is also mentioned. Yes, gypsum is present in some caves and can form attractive crystalline formations (gypsum flowers and helictites), and you may not need life to do it. You can also get stalactites (of a sort) in lava caves where molten rock has dripped from the roof. These I could believe on Ceres, but the implication is that the stalactites were of the limestone type.

Frank Coulter
Pauanui Beach
New Zealand

P.S. I enjoyed Joe Schembrie's story, though the shootout at the end was a bit like the good cowboys and the bad cowboys fighting over the gold. . . .

Dr. Schmidt:

I was shocked to read in the July/August story "Loki's Realm" that, in the year 2272, a Scot would ask for "Tea. Earl Grey with a bit of cream and sugar . . ."

Surely times will not change to such a degree!

An "Englishman" would never take cream with his tea and certainly not with Earl Grey.

Even Jean-Luc Picard never committed such a heresy.

Peter Rodgers
Danesmoor
Chesterfield
Derbyshire
England

Are you sure *they wouldn't change that much? Look at the* last *265 years! Besides, do all Englishmen have identical tastes? And I've heard Scots object*

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vehemently when referred to as "Englishmen". . . .

Stan,

Your editorial "Adapting" hit the nail on the head. Since population growth is the prime factor in human-caused global warming, isn't it time to proclaim that the Pope's stand on birth control is immoral?

Al Westerfield
Crossville, TN

Dr. Schmidt,

What a terrific essay by Jeffery Kooistra ("The Supplemental View") in the September 2007 issue. I am both a scientist (Ph.D. Chemical Engineering) and a "born again" Christian. I have never felt any conflict between my science and my faith, but I have never been able to satisfactorily explain why this is possible. Dr. Kooistra has done this most elegantly. Thank you for publishing this.

Don Hirsch
West Boothbay Harbor, ME

Dear Mr. Schmidt,

I am a subscriber in long standing (many decades) and in all that time I have never found an issue so poor that I could not read it. I have found stories I did not like and either read them to expand my horizons or passed on them, as per my tolerance level. However, that issue with the silly story and article using archaic speech and spelling, with the absurd plot did me in. It might have been a cute gimmick to mix things up a bit, but it was poorly written. And that silly piece by Schroeder! The first was tolerable, but the second was ridiculous—the characters, plotting and setting were not only unbelievable, but mutated from the first piece. Perhaps there are just fewer good stories now—fewer submissions by the Vajra's, Bechtel's, and Asaro's.

Now to Kooistra's column: I am pleased that he had an education that reconciled all the differences between religion and science. Just as I was pleased to hear how his father was a combination of Einstein, Galileo, and Paul Bunyan—I am quite sure there are millions of children who feel the same about their fathers. They just do not have the opportunity to publish their enhanced memories in a magazine. I must take exception, however, with his view that religion does not conflict with science. I have many friends, acquaintances and colleagues who were raised in religious homes. With few exceptions, they object to many aspects of science—not due to knowledge of either their religion or of science, but on principle. They have been told that <insert scientific conclusion or theory here> is wrong and so object to it, because their particular religion has told them to do so. One colleague objected to evolution because "there are still monkeys"; another to astronomy, because there is no room for Heaven. These are people who are intelligent and educated, but have been blinded in their upbringing—who was it who said, "Give a child until he is five and he is mine for life?" In line with such work, I recently read a few selections from a book that was, essentially, a Catholic's FAQ for modern times: Under the section regarding the recent problems of their priesthood caught abusing children, it stated that priests are never wrong or bad, and that anyone saying so is purely malicious. Now I know where I stand . . .

In conclusion, please vet your stories better. I know that you must hear the cry "it was better in the old days" frequently, but the concerns I mention are valid. I believe that you have let a few poorly chosen pieces slip in, as the rest of the last issue was very good.

Regards,
Dan Davies

(1) I'm sorry you didn't like the pieces you complain about, but many other readers liked those same pieces very much. Tastes differ; nobody likes everything, and nothing pleases every-

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body. And those with different tastes than yours or mine are not necessarily inferior or "wrong."

(2) Yes, I do hear "it was better in the old days" fairly often, and those cries usually follow certain patterns (which I discussed in my June 1990 editorial, "The Oldtimer Effect").

Dear Stan Schmidt,

Edward Lerner's article about RFIDs led me to recall a lively discussion I had with the socially conscious CEO of a technology company I worked with several years ago. The issue was how to target low-cost RFID development while taking positive stances on sustainable development and related societal issues. Not a simple task. Though I like the technology, in our discussion I took the position that even more important than the slippery slope of privacy erosion, presented nicely by Lerner, is an expected epidemic of Radio Frequency Induced Unemployment (RFIU) accompanying widespread RFID deployment.

US businesses have for years been offshoring manufacturing jobs, in recent times even in "soft" product-generating professions such as computer programming and patent drafting. What remains domestic is increasingly (euphemistically) called a "service economy." Enter RFID, an exciting and probably inevitable technology promising to increase efficiency in many tasks, but arriving with the potential to eliminate a great many of these service-type jobs, with no obvious replacements. When the cost of RFID or functionally similar labeling finally comes down to resemble that of bar coding, businesses will need far fewer salespeople, checkout clerks, stockroom workers, package and mail handlers, security personnel, associated managers, and several other types of employees who currently help make the world go 'round. The number of jobs that could flash evanesce in this manner is staggering. As one simple example, consider 34,000 supermarkets in the US each suddenly needing four or five fewer employees to work checkout counters or to find that mis-shelved can of beans.

Some stockholders may rejoice, but these jobs currently comprise a major route by which young people enter our economy, semi-retirees continue to be and feel productive, the marginally employable manage to get by, and families are able to sustain second incomes without compromising childcare. On the bright side, we can see this particular technological engine steaming at us from a decent distance along the track, and I believe we may have time to do more than hang out on the rails and watch what happens as it gains speed. RFID is a fascinating technology with great potential, and Lerner is right about this being fertile ground for speculative fiction. I'm looking forward to reading about the next few decades of social evolution in the next year or two of *Analog*.

Steve Bittenson
Bedford, MA

Whenever you accept our views, we shall be in full agreement with you.

—Moshe Dayan

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IT'S ANLAB TIME AGAIN

YOUR BALLOT WILL BE AUTOMATICALLY ENTERED IN OUR DRAWING FOR A FREE ONE-YEAR SUBSCRIPTION!

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Look over all your copies of *Analog* dated 2007, or refer to the index on the following pages. Pick *your three favorites in each of the following categories: novella, novelette, short story, science fact* article, and cover. If you're not sure about a piece's category, you'll find it listed both in the Table of Contents for the issue in which it appeared, and in the Index. In the event of a disagreement between the Table of Contents and the Index, the Index should be considered correct. List your choices in order of preference (your favorite in each category is #1) on the ballot below, and either mail it in or send it by e-mail. You can also vote at our website, **www.analogsf.com**. The ballot is *intended to make it easier for you to vote, but if you don't want to cut it out, feel free to copy it.*

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2007 Index

Here is the Index to 2007, *Analog*'s Volume 127. Entries are arranged alphabetically by author, with month and page. When the author's name and/or part of the entry's title is omitted, it is the same as that of the previous entry. Multiple entries by the same author are listed alphabetically according to the story/article title. Collaborations are listed under all authors with cross references. Unless otherwise noted, each entry is identified as an Alternate View (av), editorial (ed), fact article (fa), guest editorial (ge), novella (na), novelette (nt), poem (pm), Probability Zero (pz), serial (ser), special feature (sf), or short story (ss).

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UPCOMING EVENTS Anthony Lewis

16–18 November 2007
ORYCON 29 (Oregon SF conference) at Portland Marriott Waterfront, Portland, OR. Writer Guest of Honor: Robert Charles Wilson; Editor Guest of Honor: Liz Scheier; Artist Guest of Honor: Molly Harrison; Media Guests of Honor: Vic and Kelly Bonilla; Fan Guest of Honor: Jonas Saunders. Registration: $45 until 31 October, more later. Info: http://www.orycon.org/orycon29; orycon29@gmail.com; OryCon 29, P.O. Box 5464, Portland, OR 97228-5464.

16–18 November 2007
PHILCON (Philadelphia SF conference) at Sheraton Philadelphia City Center, Philadelphia, PA. Principal Speaker: Eric Flint; Artist Guest of Honor: Sue Dawe; Costuming Special Guests: Kevin Roche & Andrew Trembly. Registration: $45 until 31 October, $50 thereafter and at the door. Info: www.philcon.org; info2007@philcon.org; Philcon, Box 8303, 30th Street Station, Philadelphia PA 19101.

23–25 November 2007
LOSCON 34 (Los Angeles area SF conference) at LAX Marriott, Los Angeles, CA. Writer Guest of Honor: Robert J. Sawyer; Artist Guest of Honor: Theresa Mathe; Fan Guest of Honor: Capt. David West Reynolds; Music Guest of Honor: Dr. James Robinson. Registration: $40 until 31 August, $45 until 31 October, $50 at the door. Info: loscon.org/34/index.html; info@loscon.org; Loscon 34, 11513 Burbank Blvd, North Hollywood CA 91601.

6–10 August 2008
DENVENTION III (66th World Science Fiction Convention) at Colorado Convention Center, Denver, CO. Hotels include Adam's Mark (party hotel), Hyatt Regency. Guest of Honor: Lois McMaster Bujold; Artist Guest of Honor: Rick Sternbach; Fan Guest of Honor: Tom Whitmore; TM: Wil McCarthy. Registration (until further notice; see website): USD 175; supporting membership USD 40; child (until 12 as of 6 August 2008) USD45. This is the SF universe's annual get-together. Professionals and readers from all over the world will be in attendance. Talks, panels, films, fancy dress competition—the works. Nominate and vote for the Hugos. Info: www.denvention3.org; president@denvention.org. Denvention 3, Post Office Box 1349, Denver, CO 80201 USA.

30 October–3 November 2008
WORLD FANTASY CONVENTION at Calgary, Alberta, Canada. Guests: TBA. Registration: Attending US $100 until 30 September 2007 (limit of 850), Supporting: US $35; additional for Awards Banquet US $50. Info: www.worldfantasy.org; info@worldfantasy2008.org; World Fantasy 2008, c/o The Story Box, 1835-10 Avenue SW, Calgary, Alberta T3C 0K2 Canada. ■

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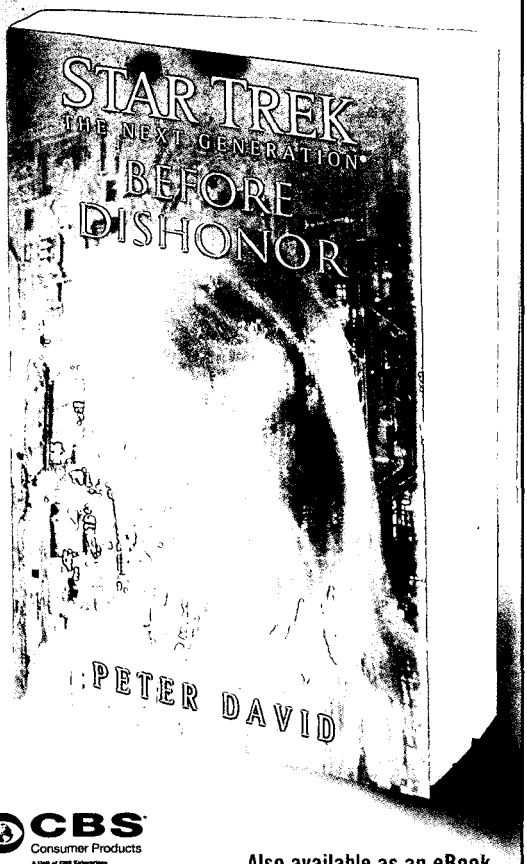

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